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ABSTRACT

This publication presents an organized collection of biology questions, designed for use in evaluation at the secondary level in Tasmania. Each item has been tried for quality and is accompanied by its difficulty percentage as well as by its content area and the mental processes required to answer it. The content areas include: Diversity, Interrelationships, Change, Living World, Organs and Systems, Interaction and Maintenance, Cellular Level, Continuity, and Evolution. The mental processes include: knowledge, comprehension, application and analysis. A Self-Moderation Scheme, designed to compare a school's or class' performance on an entire test with that of other schools, is discussed. An Error Analysis Procedure, designed to provide for a comparison of a school's or class' performance on items within each content area of the test with the performance of other schools, is detailed. (BT)

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BANK OF ITEMS FOR
H.S.C. BIOLOGY
LEVEL III AND DIVISION 1

WITH
SELF-MODERATION AND ERROR ANALYSIS PROCEDURES
BASED ON THE BANK

2

CURRICULUM CENTRE
EDUCATION DEPARTMENT OF TASMANIA

SE020 505

SELF-MODERATION SERVICE

COVER SHEET

ITEM BANK REFERENCE NAME

B	I	O	L	O	G	Y	.	L	3	.	H	S	C

SCHOOL ....

CLASS ....

NUMBER OF ANSWER SHEETS FORWARDED ....

AWARDS DESIRED	
Award	Number Desired
C	
P	
L	
N	
TOTAL	

Note: This TOTAL must be equal to the number of Answer Sheets forwarded. (i.e., do not include absentees.)

DATE SENT.........................

DATE RESULTS REQUIRED ....

RETURN RESULTS TO:

NAME ....

SCHOOL ....

PHONE ....

HOLIDAY ADDRESS ....

....

PHONE ....

Send this sheet, completed, with all Answer Sheets to:

Self-Moderation Service,
Curriculum Centre,
181 Elizabeth Street,
HOBART. 7000.

ITEMS USED						
Test Number	Bank Access Number					
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SELF-MODERATION SERVICE

BIOLOGY - LEVEL 3, H.S.C.

ANSWER SHEET

STUDENT NO. ....

STUDENT NAME ....

........................COLLEGE/SCHOOL LINE/CLASS ....

Question Number	Answer
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SELF-MODERATION SERVICE

COVER SHEET

ITEM BANK REFERENCE NAME	B	I	O	L	O	G	Y	.	D	1	.	H	S	C

SCHOOL ....

CLASS ....

NUMBER OF ANSWER SHEETS FORWARDED ....

AWARDS DESIRED	
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TOTAL	

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SELF-MODERATION SERVICE

BIOLOGY - DIVISION 1, H.S.C.

ANSWER SHEET

STUDENT NO. ....

STUDENT NAME ....

LINE/CLASS ....

.... COLLEGE/SCHOOL

Question Number	Answer
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BANK OF ITEMS

FOR

H.S.C. BIOLOGY LEVEL III and DIVISION I

WITH

COMPUTERISED SELF-MODERATION AND ERROR ANALYSIS PROCEDURES

USING THE ITEMS FROM THE BANK

D.G. Palmer, B.Sc., B.Ed.

CURRICULUM CENTRE
EDUCATION DEPARTMENT OF TASMANIA
1975

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181 Elizabeth Street, Hobart, Tasmania 7000, in July, 1975.

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* * * * * *

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(and their schools/colleges in 1974)

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* * * * * *

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* * * * * *

PREFACE

This is the second bank we have produced for an H.S.C. subject, and the first for a science subject at that level. The decision to undertake the project was made by Biology teachers, throughout the state, in the hope that the Self-Moderation Procedure which is incorporated in this bank would prove useful in the new conditions for assessment introduced by the Schools Board for this year. These conditions include full school responsibility for awards at Division 1 and the possibility of using a school assessment mark in addition to the examination result at Level III.

It must be stressed that the Self-Moderation Procedure, which is available at both Division 1 and Level III, is offered purely as a service to teachers. Results obtained using the procedure are advisory only; they are not communicated to the Schools Board and are regarded as confidential information. Teachers may act on advice received or ignore it, as they please.

The production of this bank has involved many people. I would like to thank all of them for their hard work, and to congratulate them on the success of their efforts. Nevertheless, no project is ever completely satisfactory. I would welcome suggestions for improvement and, in the meantime, must remain responsible for whatever errors and omissions there are in this book. One obvious deficiency is simply that there are not enough items and, at the time of writing, plans are already being made to prepare supplementary material to be issued at intervals over the next few years.

I hope that this bank will prove useful to teachers, not only for information about standards but also for those other purposes which are described in the introductory pages.

D.G. Palmer
14.5.'75

INTRODUCTION

Part I - The Project

1. What is an Item Bank?

Put simply, an Item Bank is an organised collection of questions (hereafter called items) which have been tried for quality. In this Bank each item is accompanied by its difficulty percentage as well as by its content area and the mental process required to answer it.

2. Possible Uses of This Bank

You should discover that the uses of this Bank are many and varied. For example, you might consider using it for at least the following purposes, and add to them any others which you think are appropriate:

(a) as a source of items for:

- constructing topic tests;
- constructing achievement tests over, perhaps, a term's work;
- providing stimulus material for a class lesson;
- presenting your students a different approach to the learning of familiar subject material;
- identifying new subject material which could broaden the scope of your teaching of particular topics;
- constructing learning exercises designed for the specific purpose of getting your students to examine why they answered some items incorrectly;
- providing yourself with examples for your own item-writing.

(b) as a basis for determining the level of achievement of your class compared to that of other classes throughout the state (Refer to Part II - The Self-Moderation Scheme, on pages xv to xxiv.)

(c) as a basis for diagnostic testing of your class (Refer to Part III - The Error Analysis Procedure, on pages xxv to xxvi.)

When using the Bank for the testing purposes mentioned in (b) and (c) above, make certain that you reproduce each item exactly as it is in the Bank, without altering either its wording or its layout. Any alteration of an item may also alter its expected difficulty and its ability to discriminate. For other purposes, however, feel free to alter the items in any way which you think would make them more usable.

Your school has received a loose-page version of the Bank, as well as this bound one. The loose-page version should make it possible for you to reproduce the items easily and quickly, with the result that you will be able to use the Bank as often as you wish, for a wide variety of purposes.

The following procedure for using the loose-page version has much to recommend it:

- photocopy whatever items you wish to use (this will allow the loose-page version to be retained intact, as a "master" copy for future use);
- trim off the access numbers and difficulty percentages;
- attach the items, in the order you prefer, to blank sheets of paper, and number each item;
- give the sheets of items to a secretary, who will cut either "scanned" or "thermofax" stencils ("scanned" ones are preferable), and print as many copies as you need.

Following this procedure will not only make unnecessary the time-consuming chore of typing, it will also allow you to make full use of those items based on tables, maps, graphs and diagrams which in many cases are too complicated or too detailed for schools to reproduce easily and accurately.

3. How the Bank Was Constructed

(a) Writing the Items

In May and June, 1974, different groups of Higher School Certificate Biology teachers (in Hobart, on the North West Coast and in Launceston) attended item-writing sessions lasting three days each. A total of about 20 teachers wrote items during these sessions. At each session, teachers worked at two alternating activities:

(i) individual work, in which each teacher thought up and wrote out test items, followed by

(ii) group work, in which each person answered everyone else's items and critically discussed them after they had all been read.

In addition to participating in these formal sessions, a number of teachers spent many after-school hours, in the evenings and at the weekend, in validating items which they had previously written. The result was that by the end of Term II, 1974, 469 acceptable items for trialling had been written by 26 teachers.

(b) Trialling the Items

The 469 items were sorted and typed into 14 tests, which were sent to all State and Independent schools with H.S.C. classes for trialling. After the answer sheets had been returned and analysed, the figures obtained from the analysis were used as a guide to determine whether each item was acceptable for publication in the Bank, or not.

(c) Publishing the Items

The validity of each item was tested twice - first, by the item writers, when they answered one another's items to determine whether they, as experts in their field, could agree on the right answers; and second, by the H.S.C.

students on whom the items were trialled. The items which proved to be valid and acceptable were finally re-ordered, re-typed, and printed in the form of this Bank.

4. Characteristics of Each Item

The three figures printed in the margin at the left of each item - one, an access number, and the other two, percentages - contain useful information about certain characteristics of the item. These characteristics include (a) the content area of the item, (b) the mental process required to answer the item (both of which are coded in the item's access number) and (c) the difficulty of the item for both Level III students and Division 1's (expressed as percentages).

Immediately following the descriptions below, is an explanation of how to read the access number of each item.

(a) Content Areas

Item writers decided that the H.S.C. Biology course, for both Level III and Division 1, should be divided into the following content areas, for the purposes of the Item Bank:

0. Diversity
1. Interrelationships
2. Change
3. Living World
4. Organs, Systems
5. Interaction, Maintenance
6. Cellular Level
7. Continuity
8. Evolution
9. Other: Scientific Method, etc.

(b) Mental Processes

To answer each item a student must use one or another of four mental processes, similar to those described and numbered by Bloom in his Taxonomy[1] (which includes six processes in all). They are process 1, knowledge; process 2, comprehension; process 3, application; and process 4, analysis. These four processes are described below in their specific relation to the items in this Bank. (Refer to Appendix B for a general description of all six processes.)

Process 1: Knowledge

This process involves a person's knowledge of specific facts, of ways of dealing with specific facts, of drilled operations and of abstractions and generalisations.

Items in this Bank which require knowledge for their answering fall mainly in the content area of Diversity, and most deal with aspects of classification.

Process 2: Comprehension

This process involves any of three mental activities:

(i) translation. Items which require translation test a student's ability to recognise a rephrasing of a group of words, or to translate such symbolic forms as diagrams, tables and graphs into words or other forms.

(ii) interpretation. Items which require interpretation test a student's ability to grasp the meaning of a piece of writing, a graph or a table - as a whole - and to understand the interrelationships of its major ideas. It may also require that he abstract generalisations from the particulars in the information given.

(iii) extrapolation. Items which require extrapolation test a student's ability to draw conclusions from what he has read or to predict trends or consequences based on a piece of writing, a table, a diagram or a graph.

The process of comprehension can be tested effectively by items based on paragraphs, tables, graphs, diagrams, etc. previously unseen by your students. Many items in the Bank are of this type.

Process 3: Application

Items which require application test a student's ability to solve a genuine problem. The solution depends on a student's ability to sift through principles, abstractions or generalisations which he already knows, and to select exactly the right one to apply. Neither the stimulus material nor the items "prompts" him in making his selection and, in general, the material is unseen. If it is familiar, the item will make the student think about it in a previously unconsidered way.

Many items in the Bank which are based on hypothetical situations require the process of application.

Process 4: Analysis

This process, like the previous two, can be tested most effectively by items based on material previously unseen, but analysis requires more sophisticated thinking than do the processes of comprehension and application.

Items which require analysis test a student's ability to recognise the bias, the underlying assumptions and organisational principles, or the errors in logic of any given communication.

(Note: As this is a "taxonomy", and not a straight classification, items which require a more advanced mental process may require earlier processes as well. For example, a student may need first to "comprehend" a graph before he is able to "analyse" it.)

(c) Difficulty

This characteristic of each item is expressed as a percentage, printed just beneath the access number. It is the percentage of all those students who got the item wrong when it was trialled. Thus a high percentage (greater than 70%) indicates a hard item, and a low percentage (less than 30%) an easy one. (Note that separate percentages are printed for Level III and for Division 1.)

If you refer to item 00842Q on page 15, you will observe that the item's difficulty is 48% for Level III and 67% for Division 1. This means that, of all Level III students on whom the item was trialled, 48% got it wrong and of all Division 1's on whom it was trialled, 67% got it wrong.

All items in this Bank have a fourth highly important characteristic in addition to the three described above. It is -

(d) Discrimination

Items which discriminate have the faculty of picking out the more capable pupils in your class. If an item discriminates well, then the more capable students will tend to get it right, while the less capable students will tend to get it wrong - no matter how hard they try to guess the right answer.

The measure used to indicate each item's faculty to discriminate among students of different abilities is the point-biserial correlation, or PBC. This two-figure decimal, although not printed in the Bank, is entered in the computer data store for each item, along with the item's difficulty percentage, its access number and its correct answer.

The PBC is based on a comparison of students' scores on one particular item with their scores on the remainder of the trial test in which that item occurred.

All items in this Bank have a sufficiently high PBC, derived from the results of trialling, to warrant their publication and use.

5. How to Read the Access Number of Each Item

You will find two of the item characteristics described above - (a) content areas and (b) mental processes - coded in the access number of each item. The following information should assist you in understanding that number:

(i) The first digit of the access number describes the content area of the item. It will be any digit from 0 to 9. (Refer to 4(a) Content Areas, above.)

(ii) The next three digits indicate the number of the item among all those items within a particular content area.

(iii) The fifth digit describes the mental process required to answer the item. That digit will be either a 1,2,3 or 4 - and indicates whether the process required is knowledge, comprehension, application or analysis. (Refer to 4(b) Mental Processes, above.)

(iv) The letter at the end of the access number is the check letter. Since the only identifications of the items which you might select for moderation are the access numbers, these letters have been included so that transcription errors will nearly all be detected. (For the mathematically inclined, they are the residues, mod 23, coded to letters but omitting I, O and S.)

Example: On page 15 of the Bank, you will find an item with the access number 00842Q.

(i) The first digit, 0, shows that this item is in the content area of Diversity.

(ii) The next three digits, 084, show that this is the 84th item in that area.

(iii) The last digit, 2, shows that this item requires the second mental process, comprehension.

(iv) If 00842 is divided by 23, the remainder is 14. When coded to the alphabet, omitting I and O, Q is obtained.

* * * * * *

Part II - The Self-Moderation Scheme

1. Background

Before 1974 nearly all Higher School Certificate subjects, at both Level III and Division 1, were assessed wholly by an external examination. In 1974, this situation changed dramatically: Division 1 assessment became wholly internal for nearly all subjects; and for six subjects an internal component within the range of 20%-50% became part of Level III assessment. By the beginning of this year, 1975, the number of subjects with an internal component at Level III had nearly doubled.

Many H.S.C. teachers have welcomed this change because of the greater scope and flexibility which it has inevitably given to their teaching. But this change has also brought teachers of nearly all subjects face-to-face with an unfamiliar problem. The problem is that most of them still consider it necessary, for many purposes, to compare the abilities of each student in the state with those of other students taking the same course of study, and teachers of Division 1 classes can no longer resort to an external examination as a means of achieving this comparability; also teachers of Level III classes have found themselves suddenly responsible, in some subjects, for up to 50% of each student's final assessment.

High school teachers faced this same problem several years ago, when external examinations were abolished for School Certificate subjects. In the late 1960's the Department's Testing Division began developing an alternative scheme which could moderate standards, as the external examinations had previously done, but which could also, unlike the externals, leave teachers ultimately responsible for the assigning of awards to their own students.

This Self-Moderation Scheme, described in the following pages, received its first use in 1971. Since then it has been widely used for moderation in those subjects for which Item Banks have been constructed. This Bank, the second to be published for a Higher School Certificate subject, is the eighth Item Bank to include the Scheme. (Refer to Appendix F for titles of the others.)

2. The General Idea

The Self-Moderation Scheme is based on the following assumptions:

- that students do not all study exactly the same content areas of a subject or learn exactly the same skills - nor do they necessarily study in the same manner and with the same emphases;
- that teachers find it desirable to give individual students awards which are based on a variety of abilities rather than on any one particular ability;

yet

- that a group of students who receive a particular award (e.g., a Credit) in a particular school should have abilities which are comparable with those of a group of students who receive the same award in any other school.

The Scheme has therefore been designed to allow subject departments and teachers substantial autonomy with regard to what abilities they test and how they test them; yet it has also been designed to ensure that students throughout the state who receive the same award in a subject are those whose abilities in that subject are comparable (though not necessarily identical).

The main characteristics of the Scheme are the following:

- it provides information about a group of students, not about individuals;
- it is based on tests chosen either by a subject department or by individual teachers within a school, not by State or Regional Committees;
- it is computer operated;
- its use, and any action following that use, are purely voluntary.

These characteristics are discussed below, and the actual procedure to be followed is described in detail on pages xix to xxiv.

3. Reasons for the Use of a Group Method

It matters little whether a student's responses to the questions are intended to be brief or lengthy - any test which requires written responses is restricted in what it can measure. For example - a student's attitudes, interests, appreciations and enthusiasms, on the one hand, or his speaking ability and manual skills, on the other, are most difficult, if not impossible, to test in this way. No test which requires written responses is capable of measuring all of a student's abilities in any subject. Awards based exclusively on the results of such tests can often be misleading.

Objective tests composed of items like the ones in this Bank, although capable of measuring a fairly wide range of abilities, are even more restricted in scope than are other types of written tests. For not only are they incapable of testing attitudes and skills in the affective and psychomotor areas mentioned above; they are also incapable of testing a student's ability to create, and to make reasoned judgements.

An objective test, however, is capable of testing a student's knowledge of a subject, and - perhaps more importantly - his ability to use the relatively higher mental processes of comprehension, application and analysis. What is more, objective tests can be constructed so that they have both validity and reliability - characteristics which are not easy to achieve with tests requiring written responses.

If a test item has validity, then it measures that particular ability which it is intended to measure. (For example, if a Biology test item - which is intended to measure only a student's understanding of a table he has just read - contains words too difficult for most students to understand, it would not be a valid item.) One measure of an item's validity is its faculty to discriminate between students of different abilities. If an item discriminates well, then the more capable students in a subject will tend to get it right, while the less capable students will tend to get it wrong - no matter how hard they try to guess the right answer.

If an item has reliability, then the result of students' attempts at that item will be repeatable regardless of when or where or how many times they answer it. (For example, those who know how to answer it will get it right on a Monday morning in Hobart and on a Friday afternoon in Devonport - in this year or any year.) An objective item can be more reliable than most other types of items because it is not subject to the whims and moods of the person who marks its answer. The answer is invariably either "right" or "wrong", no matter who marks it - even a computer.

All items in this Bank have acceptable validity and reliability; and, additionally, they are capable of testing the mental processes of knowledge, comprehension, application and analysis.

An objective test composed of items with these characteristics can be used with great effectiveness for the purpose of self-moderation. When used for this purpose, however, the results of such a test - because of its restricted scope - should not be used to place students in order of merit. Instead, the results should be used only to indicate the numbers of students in a school, or even in one class, who should receive C's, P's, L's and N's. These suggested numbers for each award would have been obtained by comparing the school's or class's performance on those items selected for the test with the performance, on the same items, of other classes throughout the state. An objective test composed of items from this Bank, then, would be effective in producing information about the abilities of a class as a whole, although it would not be particularly useful for placing individual students in order of merit.

This use of an objective test for measuring the abilities of a class, and not of individuals, should prove liberating for a teacher who desires independence and responsibility. For once a teacher knows how many of each award he can justifiably give, he is then able to use, with confidence, all the information which he has obtained about the varied abilities of his students as his basis for deciding which students will receive which awards - with the result that his awards will reflect his own subject emphases and style of teaching.

4. How the Group Method Works

(a) An objective test consisting of items selected from this Bank is given to a class. The test, because it is objective, will have all the disadvantages mentioned earlier - if the results are used to place individual students in order of merit. However, the purpose of the test is not to measure the abilities of individual students, but to measure the abilities of the class as a whole. It is assumed that a measure of the class's average performance on an objective test will also be a fair measure of the class's average performance in areas which lie outside the scope of objective testing - such as creative work and evaluation, or the affective and psychomotor areas. Therefore the test will give a fair result for the class as a whole.

(b) The result obtained from the test is simply the numbers of students who should receive each award. For example, the test may reveal that, of 30 students in a class, 5 should receive a C, 16 a P, 5 an L and 4 an N. The test result does not indicate which students should receive which awards.

(c) The teacher then considers all the information he has about the abilities of his students. Only after taking all such information into account as the basis of his individual awards, he will then give his best 5 students C's, the next 16 P's, and so on. Thus he is using far more information than the test score as the basis of his individual awards - with the result that the order of merit of his students which he finally decides on could be quite different from the order of merit of his students on the test, even though the numbers of students who receive each award will closely approximate what the test scores indicate.

5. Why Teachers Choose Their Own Tests

Teachers do not all involve their students in exactly the same content areas of a subject - nor do they all teach in the same style and with the same emphases. So why should all teachers have to give their students the same test? The problem in the past has been that, if different teachers chose different tests, then the results which teachers obtained would not have been comparable. Testing developments of the last five years have largely overcome this problem: the Self-Moderation procedure is able to compensate for differences in item difficulty and discrimination so that, regardless of which items a teacher selects from this Bank, the result for his class will still be comparable with what it would have been if he had chosen some other set of items instead.

6. The Reason for Computer Processing

The calculations required by the Scheme involve a comparison of students' answers throughout the State to items of varying difficulty and discrimination value. (Refer to Appendix C for a description of the required calculations.) Such calculations are excessively lengthy for a person to make quickly, especially when they must be made for hundreds of answers. By using a computer, tests and answers can be marked more accurately and returned to teachers more quickly than they could be otherwise.

7. How to Use This Bank for Self-Moderation

PLEASE NOTE: If a test selected from this Bank is to be used for the purpose of self-moderation, then a teacher must strictly observe the following:

1. he must NOT use the results of the test, by itself, to place his students in order of merit; and
2. he must NOT limit his teaching to the restricted scope of mental processes which a test of this sort is capable of measuring.

If a teacher fails to regard either or both of the above, then the test and its results will be invalid and unreliable - and therefore of NO USE WHATEVER for the purpose of self-moderation.

A PROFESSIONAL APPROACH IS ABSOLUTELY NECESSARY.

(a) Some Important Preliminary Points

(i) As the item data was obtained at the end of the school year, any test for self-moderation purposes either should be given near the end of the course or should be restricted to those topics which have been completed at the time of testing.

(ii) Any test for self-moderation purposes should be reasonably mixed with regard to both content areas and mental processes. A test which covers only one or two areas or processes could produce misleading results.

(iii) The same test can be used for all H.S.C. Level III or Division 1 classes, or a separate test can be selected by each teacher. Whichever course is chosen, all the following "steps" must be taken for each test, whether one or several.

(b) Steps to be Taken for Each Test

(i) If the group to be tested consists of 15 or more students, select 20-30 suitable items, taking due regard of the points in (a) above. If fewer than 15 are to be tested, increase the number of items.*

(ii) Construct an Answer Sheet for your test. (Refer to the example on page xxiii.)

(iii) Reproduce the items and Answer Sheets.

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*Select enough items so that the product of the number of students and the number of items is not far short of 300. For example, if you have 10 students, then select 30 items for your test.

(iv) Administer the test : tell the students to answer every question, even if they have to guess;

: give nearly all students time to finish comfortably;

: do not help them at all, even with instructions.

(v) Collect both the test copies and the Answer Sheets.

(vi) Number the Answer Sheets serially, starting at 1, and keep a copy of these numbers for later reference. You need not mark the answers.

(vii) Fill in completely a copy of the Cover Sheet. (Refer to the example on page xxiv.)

Note that you have received one Cover Sheet for Level III and a separate one for Division 1. Make certain that you use the appropriate one. You should make a photocopy of the appropriate Cover Sheet, and record your information on the photocopy. Retain the original as a "master" copy for future use.

NOTES: (a) Make certain that you record the Bank Access Number accurately.

(b) The Numbers of Desired Awards should represent your opinion of your class. Include here only those students for whom you have Answer Sheets - i.e., omit absentees.

(viii) Send the Cover Sheet, with all Answer Sheets, to the address given on the Cover Sheet.

(ix) You will receive back a computer printout within a few weeks.

(c) Interpretation of the Printout

(i) Checks you may wish to make:

- Have the correct Bank Access Numbers been used? If the Number of Items in Test is different from the number you wanted, a note will appear on the lines of the omitted items. Has this affected the validity of your test?
- Is the Number of Answer Sheets Received correct?
- Is the Number of Desired Awards correct? (Column D of Section III.)

(ii) What the printout sections contain:

- Section I repeats the item numbers you chose, in two orders - yours, and the order in which they appear in the Bank.
- Section II gives each student's score, according to the numbers you wrote on the Answer Sheets.

- Section III shows how your result was obtained.
- Section IV is your result - particularly note the Class Result part.
- Section V is the error analysis result.

(iii) What the Result means:

- If you are "within" the range, your Numbers of Desired Awards (Column D) agree with the general state standard. You can now go ahead and, as indicated in 4(c) above, give these awards to the students you think most deserve them.
- If you have been "hard" or "generous", the printout will tell you how to change your Desired Awards and recalculate to come within the range, if you decide you want to. Note that the final formula is $R = T \pm K\sqrt{V}$, and that the value of K used is given at the top of Column G.
- The Individual Student Results are not very useful because the ranges in Column C overlap so much. This is a reflection of the uncertainties discussed in 3 above.

(iv) What the Error Analysis means:

This section looks at your students' results on various sub-sets of your test items. For each sub-set, two comparisons are made:

- with the average state data - i.e., your students' results are compared with the average state results;
- with your expectations - i.e., your students' results are compared with what they should achieve if their ability is as in your Desired Awards.

In both cases the number of errors actually made is compared with the number of errors to be expected, for each sub-set of items. You should note the following:

- A comment is made only if either (or both) of the comparisons shows a difference from the calculated result.
- A "High" comment would mean your students have made more errors than expected.
- A "Low" comment would mean your students have made fewer errors than expected.
- The possible sub-sets are listed in Appendix D.

A more detailed discussion of the whole procedure is in Part III, following.

(v) Other Information from the Printout:

- If you chose an item which has been removed from the Bank, a note will appear in Section I. You should delete such items from this book, so that this will not occur again.
- A frequency distribution of your class results can be easily prepared from Section II.

(vi) Replication:

If the Total of Student Scores is very different from R, it is possible that you made a bad choice of items for your class. If you suspect that this may be so, it would be most desirable that you repeat the whole procedure, using a different set of items. The second result should enable you to decide whether the first was accurate or whether you should alter your Desired Awards.

8. The Up-Dating Mechanism

A point which has not yet been mentioned is that all information fed into the computer (i.e., the Answer Sheets and your estimates) is used to bring the item characteristics up-to-date each time an item is used. The results of this are that the advice you receive will become more accurate as time goes by, and that it is therefore quite in order for you to use the same items - or even the same test - year after year. This is one of the real economies of an Item Banking approach.

* * * * * *

9. A Sample Answer Sheet

SELF-MODERATION SERVICE

BIOLOGY - LEVEL 3, H.S.C.

ANSWER SHEET

STUDENT NO. 13

H. M. COLLEGE/~~SCHOOL~~ STUDENT NAME Bill Smith

LINE/CLASS 41

Question Number	Answer
1	D
2	C
3	A
4	~~C~~ D
5	B
6	A
7	D
8	~~C~~ ~~A~~ C
9	B
10	D
11	C
12	B
13	A
14	C
15	B
16	A
17	A
18	C
19	C
20	A
21	
22	
23	
24	
25	
26	
27	
28	
29	
30	

28

10. A Sample Cover Sheet

SELF-MODERATION SERVICE

COVER SHEET

ITEM BANK REFERENCE NAME														
	B	I	O	L	O	G	Y	.	L	3	.	H	S	C

SCHOOL H. M. C

CLASS all L.3

NUMBER OF ANSWER SHEETS FORWARDED 150

AWARDS DESIRED	
Award	Number Desired
C	18
P	83
L	38
N	11
TOTAL	150

Note: This TOTAL must be equal to the number of Answer Sheets forwarded. (i.e., do not include absentees.)

DATE SENT 10 August 1975

DATE RESULTS REQUIRED end Sept

RETURN RESULTS TO:

NAME Mr B. J. Oliver

SCHOOL H. M. C

PHONE 343 166

HOLIDAY ADDRESS 15 Eden St.
Campbell Town Tas

PHONE 003-812654

Send this sheet, completed, with all Answer Sheets to:

Self-Moderation Service,
Curriculum Centre,
181 Elizabeth Street,
HOBART. 7000.

ITEMS USED						
Test Number	Bank Access Number					
1	5	0	1	1	4	X
2	5	0	1	2	4	J
3	4	0	0	9	2	D
4	4	0	1	0	2	P
5	4	0	1	1	2	A
6	4	0	1	2	2	L
7	0	0	0	3	1	J
8	0	0	2	0	1	U
9	9	0	2	2	4	V
10	9	0	1	4	3	G
11	8	0	0	3	1	Q
12	8	0	0	5	4	Q
13	7	0	0	6	1	D
14	7	0	0	7	1	P
15	7	0	0	8	2	B
16	1	0	1	0	1	E
17	1	0	1	1	1	G
18	2	0	2	2	2	F
19	3	0	0	1	1	W
20	6	0	2	0	2	M
21						
22						
23						
24						
25						
26						
27						
28						
29						
30						

Part III - The Error Analysis Procedure

1. The General Idea

The Self-Moderation Scheme is designed to compare a school's or class's performance on an entire test with that of other schools in the state. However, a test used for the purpose of self-moderation contains several content areas and requires several mental processes. The Error Analysis Procedure is designed to carry the comparison one stage further: it provides for a comparison of a school's or class's performance on items within each content area of the test, and that area's sub-divisions, with the performance, on similar items, of other Tasmanian schools. Therefore its purpose is primarily diagnostic.

Use of the Error Analysis Procedure should help teachers pinpoint particular areas of the syllabus for remedial teaching, for their class as a whole. This use of the Bank might be most effective early in the year, when moderation of standards is not so great a concern as is the selection of teaching emphases.

2. How the Procedure Works

The analysis of students' errors in answering test items will be included on the same computer printout which contains the results of self-moderation. If a teacher decides to use a test for diagnostic purposes in Term I, he can largely ignore the moderation advice, and mainly weigh the error analysis section of the printout. In this section, error analyses will be printed only for those areas of the test in which the class's performance is either above or below the derived standard. The analyses themselves will simply be lists of phrases which describe the stimulus material on which the items were based and the mental processes required to answer them.

The phrases on which the error analysis is based may be found in Appendix D, which contains lists of mental processes, of item difficulties, of possible errors and of sub-divisions within each content area. These lists of sub-divisions within each content area were drawn up as an attempt to answer the question: What are the properties of each item which might cause students difficulty in answering it correctly?

The lists, obviously, are not exhaustive. They may need to be added to and revised later. Comments on them will determine future modifications. The lists intentionally do not include such subjective considerations as the stimulus material's interestingness, relevance to students' lives, etc., because these would vary enormously from student to student. Nevertheless, the lists were conceived as an effort to "get at" whatever it is that makes students unable to answer certain items correctly.

An Example

Suppose that a teacher receives the following error analysis result for a test:

Basis of Analysis	Number of errors made	Number of errors expected if your group is:		Comment re number of errors made if group is:	
		average	as desired	average	as desired
1. Content Area					
Diversity	153	140-127	125-104	High	High
Classification, levels of	32	35-24	30-21	Average	High
Classification, animals	47	25-17	21-14	High	High
Organs, systems	63	63-49	55-38	Average	High
Animal systems	55	32-25	27-18	High	High
Evolution	41	57-48	54-43	Low	Low
2. Mental Processes					
Comprehension	239	240-212	227-198	Average	High
Translation	77	53-39	48-35	High	High
Distinguishing Assumptions	26	32-27	30-24	Low	Average
3. Difficulty					
Easy items (<30%)	83	74-61	68-52	High	High
4. Other Types					
Classifying Organisms	54	33-22	30-19	High	High

The teacher might draw the following conclusions:

(a) His class is below average, and also below expectation, in several content areas. These areas are to do with classification, particularly of animals. This weakness is most probably in the comprehension type of mental process, and especially where translation is involved.

(b) On the other hand, his class has done well in questions about evolution and, probably in this connection, is above average in distinguishing assumptions made.

(c) They have not done well with the easy items.

He may decide, on this evidence, that some intensive work on animal classification should be done, perhaps at the expense of time planned to be spent on aspects of evolution.

* * * * * *

Part IV - The Construction of Tests

The following suggestions may assist you in constructing a test consisting of items from this Bank, regardless of the test's purpose:

1. Decide on the types of items you are looking for. The best way to do this may be to draw up your own blueprint (similar to the ones in Appendix A) for the sections of the course which you wish to test. You will then be able to fill the cells of the blueprint with the numbers of items which you require for each content area and mental process.
2. Consult the table of contents for the page numbers of each content area.
3. Select your items, remembering that the fifth digit of the access number indicates the mental process required for answering them. Also, take into account the difficulty percentage of the items which you select. Note that two difficulty percentages are printed beneath the access number of each item - the first for Level III and the second for Division 1. When "NS" is printed instead of a percentage, it means that the item is "not suitable" for inclusion in an achievement test at the level indicated.
4. Photocopy the items you select, and get a secretary to cut "scanned" stencils of them and print them (as described on page x); or

   Make a list of the serial numbers of the items you select, in the order in which you want them typed, and hand this book to a typist. She should type only what is to the right of the margin, with your own numbering system.

* * * * * *

NOTE ON THE SECURITY OF ITEMS

If this Bank is to be used successfully from year to year, it is obvious that students must not be allowed to retain copies of the items indefinitely. Therefore, in the interest of all teachers, it is suggested that you do the following:

1. Collect all test papers containing items from this Bank immediately after use.
2. Collect all papers containing Bank items used for other purposes within a reasonable length of time, but make it clear to students that you want all papers returned.
3. Keep the Bank itself secure.

* * * * * *

THE ITEMS

The classification system used in this item bank is from "The Catalogue of Living Things", p.762, Web of Life, 2nd edition, 1973.

Taxonomy systems from the previous edition or from other texts have been avoided as far as possible.

Diversity

00011M
L.III - 24%
D1 - 30%

The difference between organisms is referred to as their

A. likeness.
B. characteristic.
C. structure.
D. diversity.

00021Y
L.III - 47%
D1 - NS

Classification of plants is based mainly on observations of the differences in their

A. geographical distribution.
B. reproductive structures.
C. root, stem and leaf structure.

00031J
L.III - 25%
D1 - 23%

Which one of the following statements about viruses is true?

A. They reproduce only in animals.
B. They behave as if they were plants.
C. They always occur associated with bacteria.
D. They are completely inactive outside the host's living cells.

00041V
L.III - NS
D1 - 46%

An aerobic condition is a condition in which

A. nothing can survive.
B. bacteriophage attack bacteria.
C. bacteriophage die from lack of oxygen.
D. oxygen is available.

00051F
L.III - 19%
D1 - 29%

The best evidence that two populations belong to the same species is that they have

A. similar characteristics.
B. infertile offspring produced from interbreeding in captivity.
C. the same niche requirements.
D. fertile offspring produced from interbreeding under natural conditions.

00061R
L.III - 50%
D1 - NS

A liverwort does not have

A. rhizoids.
B. chloroplasts.
C. conducting vessels.
D. spores.

00071C
L.III - 30%
D1 - NS

As we consider the organisms from species to phylum there is an increase in

A. unity.
B. diversity.
C. structural similarity.
D. colour similarity.

00081N
L.III - 22%
D1 - 35%

Before a scientist can classify a newly discovered specimen of plant, he must make a careful study of its

A. relationships in the plant and animal community.
B. colour.
C. structure.
D. adaptability.

00091Z
L.III - 18%
D1 - NS

Moulds, yeasts and mushrooms differ from nearly all other plants in that they

A. lack cell walls.
B. do not photosynthesize.
C. have no means of sexual reproduction.
D. have no means of dispersal.

00101K
L.III - 66%
D1 - 75%

The procaryotic cells in the following are

A. all algae.
B. blue-green algae.
C. fungi.
D. leucocytes.

00111W
L.III - 59%
D1 - 62%

In which one of the following respects do viruses differ from cellular organisms?

A. They multiply in the tissues of animals and plants.
B. They contain genetic material.
C. They can be crystallised.
D. They can be studied under the electron microscope.

00121G
L.III - 71%
D1 - 70%

Photosynthesis would never be carried on by any organisms belonging to the

A. bacteria.
B. fungi.
C. flagellates.
D. bryophytes.

00131T
L.III - 20%
D1 - 31%

There are many more kinds of bacteria than there are shapes of bacteria. Therefore bacterial taxonomists

A. use characteristics other than structure in their classification schemes.
B. base their classification only on nutrient requirements.
C. classify bacteria primarily according to colour.
D. use the electron microscope to determine the shape of bacteria.

00141D
L.III - NS
D1 - 62%

Which of the following properties is NOT shared by both viruses and bacteria?

A. They are killed by high temperatures.
B. They can survive outside living organisms.
C. They contain nucleic acid and protein.
D. They can multiply only in living cells.

00151P
L.III - 28%
D1 - 43%

The fact that best supports the idea that viruses are living is that they

A. are made of common chemicals.
B. duplicate themselves.
C. cause disease.
D. penetrate cell membranes.

00161A
L.III - 77%
D1 - 79%

A major disadvantage of the spores of certain tracheophytes as opposed to the majority of seeds of angiosperms is that

A. the spores contain little food reserves.
B. the spores are not easily dispersed.
C. the spores require special conditions for germination.
D. relatively few spores are produced.

00171L
L.III - 19%
D1 - 21%

A major difference between ferns and gymnosperms is that

A. ferns do not have a vascular system.
B. alternation of generations is more conspicuous in gymnosperms.
C. gymnosperms are dispersed by seeds, ferns by spores.
D. ferns do not have roots, only underground stems.

00181X
L.III - 26%
D1 - 27%

Which of the following distinguishes angiosperms from all other plants?

A. large, woody stems
B. flowers
C. seeds
D. stem, root and leaves

00191H
L.III - 39%
D1 - 48%

Plants which belong to the same order also belong to the same

A. family.
B. class.
C. genus.
D. species.

00201U
L.III - 73%
D1 - NS

It is common to all flowers that they

A. have petals.
B. have stamens.
C. are borne by angiosperms.
D. are brightly coloured.

01141Q
L.III - NS
D1 - 31%

Wind-pollinated flowers typically have

A. pistils with enlarged or branched tips.
B. brightly coloured petals.
C. enlarged sepals.
D. glands at the base of the petals which secrete nectar.

00211E
L.III - 26%
D1 - 24%

Which plant does not belong to the same phylum as the other three?

A. penicillium
B. mushroom
C. bird's nest fungus
D. fern

00221Q
L.III - 28%
D1 - 28%

Which of the following are the most closely related?

A. two genera of the same family
B. two orders of the same class
C. two classes of the same phylum
D. two species of the same genus

00231B
L.III - 30%
D1 - 32%

Two species which belong to the same genus must

A. be indistinguishable from one another without close study.
B. live in similar environments.
C. belong to the same family.

00241M
L.III - 36%
D1 - 40%

Usually the members of a family of organisms are less alike than the members of a/an

A. order.
B. genus.
C. class.
D. phylum.

00251Y
L.III - NS
D1 - 53%

Which of the following statements about a biological key is not true?

A. It may be used to distinguish between species.
B. It may be used to distinguish between genera.
C. It may be based on the colour of an organism.
D. It may be used to give an idea of the number of organisms in a species.

00261J
L.III - 22%
D1 - 35%

On a group of islands there are isolated populations of two types of birds. Which of the following observations would be most important in classifying these birds at the species level?

A. The birds live in similar habitats.
B. The birds have a different coloured plumage.
C. The birds have a common fossil ancestor.
D. The birds will interbreed and produce fertile offspring.

00271V
L.III - 44%
D1 - 46%

Which of the following is not a common characteristic of both the flatworms and the jellyfishes?

A. one opening to the gut
B. need for a watery environment
C. possession of reproductive cells
D. radial symmetry

00281F
L.III - 33%
D1 - NS

Which of the following objects is least likely to be termed radially symmetrical?

A. saucer
B. jam jar
C. hen's egg
D. coffee pot

00291R
L.III - NS
D1 - 64%

The most distinctive features of coelenterates are

A. bilateral symmetries.
B. jointed legs.
C. dorsal and ventral nerves.
D. stinging cells.

00301C
L.III - 61%
D1 - NS

The best way to distinguish between the members of the Phylum Platyhelminthes (flatworms) and the Phylum Nematoda (roundworms) is to note that

A. nematodes are segmented and platyhelminths are not.
B. platyhelminths are not usually parasitic while nematodes are.
C. platyhelminths are usually large and nematodes small.
D. nematodes have two openings to their digestive tract and platyhelminths one or none.

00311N
L.III - 56%
D1 - 54%

Ticks, crabs, spiders, and grasshoppers all have in common

A. the same number of segmented legs.
B. a notochord.
C. an exoskeleton of chitin.
D. a closed pump circulatory system.

00321Z
L.III - 16%
D1 - 12%

Millipedes and cockroaches are classified in the same phylum. Which one of the following similarities would be of least use in deciding on this classification?

A. Both are segmented and have legs attached to some of the segments.
B. Both have tough external skeletons.
C. Both live under stones or in woodheaps.
D. Both have a tubular digestive system.

00331K
L.III - 31%
D1 - 28%

A horseshoe crab can be distinguished from a seahorse by its

A. jointed legs.
B. bilateral symmetry.
C. radial symmetry.
D. cilia.

00341W
L.III - 65%
D1 - 59%

Which of the following lists of animals all belong to the same phylum?

A. insects, crabs, worms, spiders
B. fish, mammals, birds, snakes
C. snails, worms, snakes, centipedes
D. sponges, coelenterates, protozoa, ciliates

00351G
L.III - 77%
D1 - 77%

A vertebrate animal could be positively identified as a member of the class Agnatha if it lacked

A. scales.
B. jaws.
C. gill slits.
D. limbs.
E. lungs.

00361T
L.III - 74%
D1 - NS

Which of the following features is not found in all classes of chordates?

A. notochord
B. gill slits
C. bony skeleton
D. dorsal hollow nerve cord

00371D
L.III - 34%
D1 - NS

A characteristic which mammals, birds, reptiles, amphibians and bony fish all have in common is

A. scales.
B. a three-chambered heart.
C. a hollow dorsal nerve tube.
D. none of these.

00381P
L.III - 30%
D1 - 29%

Of the features listed, which one distinguishes the members of the class Amphibia from those of the class Reptilia?

A. feeding habit
B. ability to swim
C. aquatic larvae
D. tail development

00391A
L.III - 44%
D1 - 55%

The scientific name for the domesticated cat is Felis domestica. The word "Felis" designates its

A. species.
B. genus.
C. variety.
D. family.
E. order.

00401L
L.III - 38%
D1 - 46%

The word "domestica" refers to the cat's

A. species.
B. genus.
C. variety.
D. family.
E. order.

00411X
L.III - 45%
D1 - NS

Which of the following pairs of characteristics best describes all species of mammals?

A. They have hair and a placenta develops in the pregnant females.
B. They have hair and the females never lay eggs.
C. They have hair and the females suckle the young.
D. The female suckles the young from mammary glands and when pregnant develops a placenta.

00421H
L.III - 49%
D1 - 47%

If an astronaut claimed to have discovered life on another planet, the substance he found would have to

A. be made of carbon-containing molecules.
B. respond to environmental stimuli.
C. be able to move freely.
D. contain water.

00431U
L.III - NS
D1 - 35%

(N.B. The Student's Manual should be used in answering this question.)

A green covering was observed on the surface of a lake. When viewed beneath the microscope, it was found that the green colour was composed of small threads, each containing a number of cells. Using the information on pages 2 and 3 of Ex. 2-4 of the Student's Manual, Part I, which of the following plants could cause this green colouring?

A. bacteria
B. water moulds
C. red algae
D. blue-green algae

00442F
L.III - 14%
D1 - 16%

The seaweed Acetabularia mediterranea would be expected to resemble most closely

A. Mediterranea crassa.
B. Mediterranea crenulata.
C. Acetabularia crenulata.
D. Crenulata acetabularia.

00452R
L.III - 17%
D1 - 28%

Which two plants in the following list are considered to have the most characteristics in common?

Common Name	Scientific Name
King Billy pine	Athrotaxis selaginoides
native pear	Pomaderis elliptica
twining pea	Glycine clandestina
golden pea	Aotus villosa
dogwood	Pomaderis apetala
Huon pine	Dacrydium franklinii

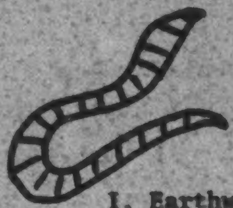
A. twining pea and golden pea
B. dogwood and native pear
C. Huon pine and King Billy pine
D. native pear and twining pea

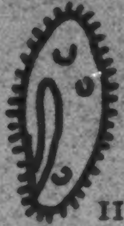
00462C
L.III - 39%
D1 - 29%

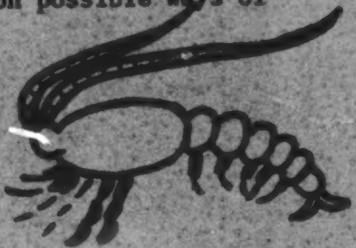
Of the following, the pair of organisms which would be most similar to each other would be in the

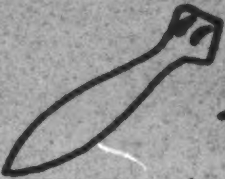
A. same class but different orders.
B. same phylum but different classes.
C. same family but different genera.
D. same kingdom but different phyla.

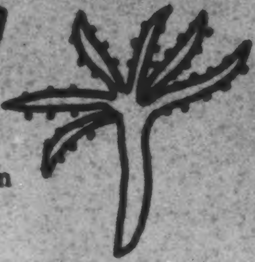
The following five questions are based on possible ways of classifying the animals pictured below.

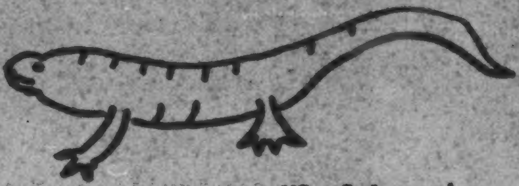

I. Earthworm


II. Paramecium


IV. Crustacean


III. Planarian


V. Hydra


VI. Salamander

00472N
L.III - 17%
D1 - 24%

If IV is placed in one group and I,II,III,V and VI in another, the basis of this classification would be

A. bilateral symmetry versus radial symmetry.
B. exoskeleton versus endoskeleton or no skeleton.
C. segmentation versus no segmentation.
D. tubular gut versus sac.

00482Z
L.III - 31%
D1 - NS

If IV and VI are placed in one group and I,II,III and V in another, the basis of this classification would be

A. backbone versus no backbone.
B. segmentation versus no segmentation.
C. special respiratory organs versus diffusion of gases through body wall.
D. tubular gut versus sac.

00492K
L.III - 12%
D1 - 26%

If I and IV are placed in one group and II,III and V are placed in another, the basis of this classification is most likely

A. segmentation versus no segmentation.
B. backbone versus no backbone.
C. lungs versus no lungs.
D. bilateral symmetry versus radial symmetry.

00502W
L.III - NS
D1 - 54%

Which of the following could not be used to divide the animals into two groups?

A. terrestrial habitat
B. producer versus consumer
C. blood versus no blood
D. appendages versus lack of appendages

00512G
L.III - 28%
D1 - 44%

Which of the animals has an endoskeleton?

A. I.
B. III.
C. IV.
D. VI.

The following questions are based on the table set out below.

	ORGANISM I	ORGANISM II	ORGANISM III	ORGANISM IV
PHYLUM	Arthropoda			
CLASS	Hexapoda			
ORDER	Lepidoptera	Lepidoptera		
FAMILY	Tortricidae	Psychidae		Tortricidae
GENUS	Archips	Solenobia	Archips	Bulia
SPECIES	rosana	walshella	fervidana	pinatubana

00522T
L.III - 23%
D1 - 31%

Which two organisms are most closely related?

A. I and II
B. I and III
C. I and IV
D. II and III

00532D
L.III - 22%
D1 - 29%

Which organisms belong to the phylum Arthropoda?

A. I and III only
B. I,II and IV only
C. I and IV only
D. I,II,III and IV

00542P
L.III - 27%
D1 - 38%

Which of these belong to the class Hexopoda?

A. I and III only
B. I,II and IV only
C. I and IV only
D. I,II,III and IV

00552A
L.III - 49%
D1 - 64%

Which organisms belong to the same family?

A. I and IV only
B. III and IV only
C. I,III and IV only
D. I,II,III and IV

00562L
L.III - 59%
D1 - 60%

Which of these organisms would have an internal skeleton?

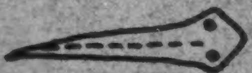
A. none of them
B. all of them
C. II,III,IV only
D. Not enough information is given to decide.

00642Y
L.III - NS
D1 - 59%

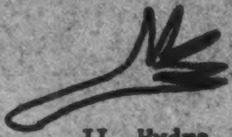
A small, bluish flower having 5 sepals, 5 petals of varying sizes, 10 stamens, and a single pistil is most probably a

A. gymnosperm.
B. fern.
C. monocotyledon.
D. dicotyledon.

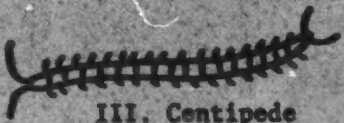
The questions following are based on the animals pictured below.



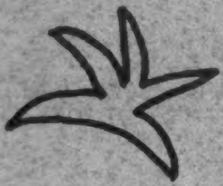
I. Planarian



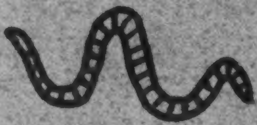
II. Hydra



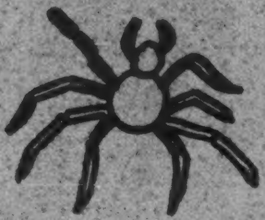
III. Centipede



IV. Starfish



V. Earthworm



VI. Spider

00572X
L.III - NS
D1 - 28%

III and VI can be clasified differently from the others on the basis of

A. possession of blood.
B. number of body layers.
C. presence of a nervous system.
D. presence of jointed appendages.

00582H
L.III - 17%
D1 - 24%

I, II and IV can be clasified differently from the others on the basis of having

A. no segmentation.
B. radial symmetry.
C. an exoskeleton.
D. jointed appendages.

00592U
L.III - NS
D1 - 56%

II and IV can be clasified differently from the others on the basis of having

A. segmentation.
B. an exoskeleton.
C. radial symmetry.
D. stinging cells.

00602E
L.III - 66%
D1 - 55%

Which of the following represents organisms that belong to the same phylum?

A. I and II
B. II and V
C. III and V
D. III and VI

00612Q
L.III - NS
D1 - 31%

Which of the pictured organisms belongs to a phylum that includes mostly parasitic forms?

A. I
B. II
C. IV
D. VI

00622B
L.III - 25%
D1 - 31%

Which of the pictured organisms have digestive systems with only one opening?

A. I and II only
B. I and V only
C. II and III only
D. II and V only

00632M
L.III - 50%
D1 - 55%

Plants may be described and consequently classified into their main groups (phyla and classes) using characteristics other than their reproductive structures. A fungus could be described as a plant which

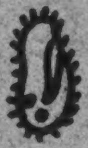
A. is composed of filaments and does not possess roots, leaves or chlorophyll.
B. is composed of filaments in close contact with algal cells but does not possess chlorophyll.
C. is non-vascular, possesses both chlorophyll and leaves, but has no true roots.
D. contains chlorophyll, but does not possess stems, roots, or leaves.

00652J
L.III - 55%
D1 - 67%

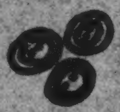
A small, flat, green plant without stem or root is found growing along the banks of a stream. It is attached loosely to the soil by rhizoids and is most probably

A. an alga.
B. a club moss.
C. a liverwort.
D. a lichen.

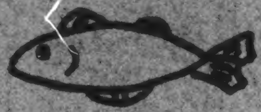
The questions below are based on the following illustrations.



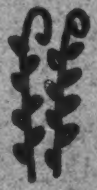
I. Paramecium
(Protozoa)



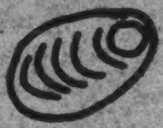
II. Chlorella
(Chlorophyta)



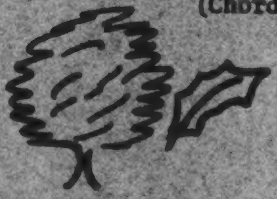
III. Fish
(Chordata)



IV. Moss
(Bryophyta)



V. Clam
(Mollusca)



VI. Oak
(Angiospermopsida)

00662V
L.III - 17%
D1 - 38%

If I and II are classified differently from all the others, it is probably because they both are

A. green.
B. nucleated.
C. unicellular.
D. multicellular.

00672F
L.III - 12%
D1 - 20%

If II, IV, and VI are classified differently from all the others, it is probably because they

A. reproduce sexually.
B. are multicellular.
C. have plastids containing chlorophyll.
D. lack conducting tissue.

00682R
L.III - 36%
D1 - 46%

If VI is *not* classified with any of the other five, it is probably because it has

A. flowers.
B. chlorophyll.
C. definite nuclei.
D. heterotrophic nutrition.

00692C
L.III - 55%
D1 - 67%

A plant that has parallel veins in its leaves and seeds not easily split or divided is most probably a

A. fern.
B. grass.
C. eucalypt.
D. moss.

00702N
L.III - 9%
D1 - 18%

Suppose you found a plant with a stem 3 m high and large leaves. The plant produced spores that grew into small flat green structures. It would be clasified as a

A. moss.
B. fern.
C. pine.
D. alga.

00712Z
L.III - 26%
D1 - 37%

A non-vascular plant that lacks photosynthetic pigment could properly be classified as

A. a fungus.
B. a fern.
C. a moss.
D. an alga.

00722K
L.III - 19%
D1 - 18%

In which one of the following pairs are the organisms most closely related taxonomically?

A. *Sylvilagus floridanus* and *Neotama floridana*
B. *Neotoma floridana* and *Peromyscus gossypinus*
C. *Peromyscus gossypinus* and *Peromyscus nuttalli*
D. *Peromyscus nuttalli* and *Sylvilagus floridanus*

00762D
L.III - 61%
D1 - NS

A group of biologists agree that a plant is a fern, an angiosperm or a conifer. To classify the plant more accurately an investigation of all except one of the following structures would be useful. Which one would *not* be of use?

A. flowers
B. seed
C. spore cases on leaves
D. stalked spore cases

Suppose you returned from a biological excursion with animals having the following characteristics:

Animal 1	Animal 2	Animal 3	Animal 4	Animal 5
hair	feathers	hair	scales	shell
backbone	backbone	backbone	backbone	muscular foot
claws	claws	no claws	claws	gills

00742G
L.III - 14%
D1 - NS

Animal 5 is most likely to be

A. a mollusc.
B. an annelid.
C. an echinoderm.
D. a chordate.

00752T
L.III - 27%
D1 - NS

The two most closely related animals are

A. 1 and 3.
B. 1 and 2.
C. 2 and 3.
D. 1 and 4.

This information relates to the following questions.

> Eucalyptus amygdalina and Eucalyptus tasmanica have been identified in stands of eucalypts occupying a dry hillside habitat. The other eucalypts in the stand appear to be a range of intermediates from Eucalyptus amygdalina to Eucalyptus tasmanica.

00732W
L.III - 36%
D1 - 54%

Which one of the following best explains the existence of this range of intermediates?

A. There are slight differences in the environments of the trees.
B. Eucalyptus amygdalina and Eucalyptus tasmanica can interbreed to produce hybrids.
C. Eucalyptus amygdalina and Eucalyptus tasmanica can interbreed to produce hybrids which are fertile.

01132F
L.III - 70%
D1 - 89%

According to the definitions in the Web of Life, these two types of eucalypts should be described as

A. two different species of the same genus.
B. two families of the same species.
C. two different species of different genera.
D. two races of the same species.

00772P
L.III - 53%
D1 - 68%

Without knowing the common names of Poa pratensis L., Poa annua L., and Poa autumnalis Muhl., you know immediately that they are closely related and in the same

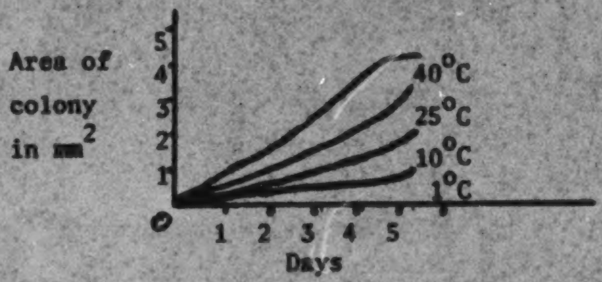
A. order.
B. family.
C. genus.
D. species.

00782A
L.III - NS
D1 - 94%

A certain species of bacteria is found to be growing on the inside of concrete water pipes, carrying drinking water. How do these bacteria acquire energy?

- A. The bacteria feed on passing viruses.
- B. The bacteria feed anaerobically on the water.
- C. The bacteria digest the concrete.
- D. The bacteria ingest each other.

A particular species of bacteria is normally found in bottled milk. An agar medium was used to measure growth curves and the following results were obtained:



00792L
L.III - 29%
D1 - 52%

It would be reasonable to conclude from the graph that

- A. growth reaches a maximum at 5 days.
- B. these colonies have a maximum size of 4 mm^2 area.
- C. the area of a colony does not depend on temperature.
- D. milk infected by this bacterium is best kept in the refrigerator.

00802X
L.III - 82%
D1 - 86%

In recent studies of food poisoning from rice meals, a bacterium (*Bacillus cereus*), common to raw cereal grains, has been shown to be responsible. However, Topley and Wilson's *Principles of Bacteriology and Immunology* - the bacteriologist's bible - bluntly states that *Bacillus cereus* is "... non pathogenic to man ...". The optimum growth temperature of *Bacillus cereus* is about 30°C and it is probable that food poisoning results from rice being boiled, stored in bulk at room temperature, and fried up as required. A definite conclusion from this information would be that

- A. boiled rice should be stored in a refrigerator.
- B. *Bacillus cereus* is a non-pathogenic organism.
- C. care should be taken when eating rice meals.
- D. the bacteriologist's bible needs revision.

00812H
L.III - NS
D1 - 40%

Bacteria from the blood of a mammal were spread onto several agar plates and then incubated at 37°C. No bacterial colonies grew. The most likely explanation for this is that the

- A. temperature was unfavourable for the growth of bacteria.
- B. agar lacked some essential food factor or factors present in the blood.
- C. bacteria grew but did not reproduce.
- D. bacteria were killed by being moved.

00822U
L.III - 33%
D1 - 34%

An individual can suffer from many colds in his lifetime because

A. the cold virus is extremely virulent.
B. antibodies against the cold virus cannot be produced.
C. antibodies produced against one cold virus will not give immunity against other cold viruses.
D. immunity to the viruses that produce colds is probably not lifelong.

00832E
L.III - 49%
D1 - 62%

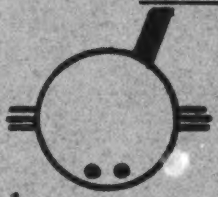
When first studying Hydra, Trembly thought that it was a plant. One of the facts that might have caused him to change his mind was that he found that Hydra

A. could reproduce sexually.
B. produced motile gametes.
C. produced buds.
D. took in organic material for food.

00842Q
L.III - 48%
D1 - 67%

Two populations of lemmings are separated by a mile-wide river. One can be characterized by brown fur, while the other is characterized by brown and white spotted fur. When members of these two populations were placed together they were found to interbreed and produce sterile offspring. The best interpretation of this data is that the two populations are

A. the same species.
B. sub-species of the same species.
C. the same species, but have become distinct in appearance because of the physical barrier (river) separating them.
D. the same genus but different species.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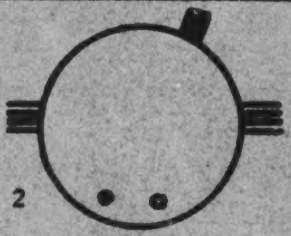
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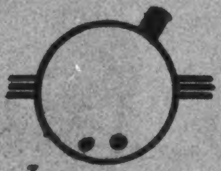
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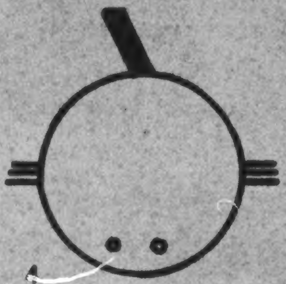
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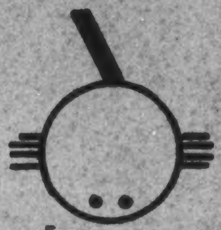
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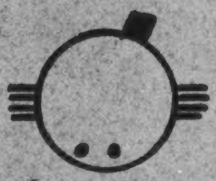
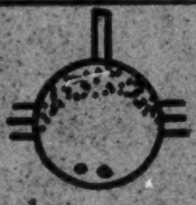

6

00852B
L.III - 69%
D1 - 72%

These are stylized diagrams of living organisms. At the first level of classification, the organisms that should be grouped together are

A. 2, 4.
B. 1, 3, 4.
C. 2, 3, 6.
D. 4, 5.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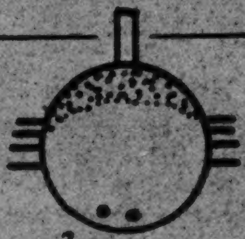
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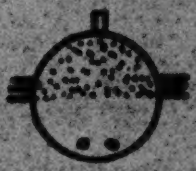
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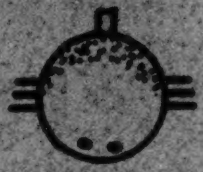
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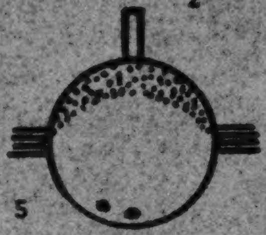
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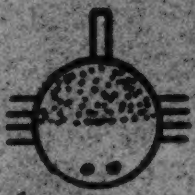

6

00862M
L.III - 63%
D1 - 62%

These are stylized diagrams of living organisms. At the first level of classification, the organisms that should be grouped together are

A. 1, 2, 5, 6.
B. 5, 3.
C. 3, 6.
D. 2, 5.
E. 2, 5, 6.

00872Y
L.III - 57%
D1 - 71%

The robin redbreast was called Erithaceus rubecula and considered to be in the family of warblers (Sylviidae). Since that time this genus has been placed in the family of thrushes (Turdidae). The name of this bird should now be

A. Turdus rubecula.
B. Erithacus rubecula.
C. Turdus exsylviida.
D. Sylviidus erithaca.

The following pairs of organisms provide the answers for the questions below.

A. hawk - owl
B. great dane - terrier
C. lizard - grasshopper
D. kangaroo - rabbit

00882J
L.III - NS
D1 - 57%

Which pair shows the closest taxonomic relationship between individuals?

00892V
L.III - 40%
D1 - 42%

Which pair shows the least taxonomic relationship between individuals?

00902F
L.III - 17%
D1 - 23%

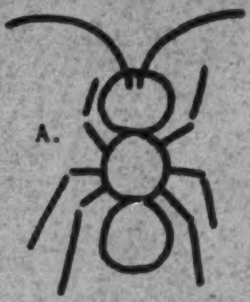
Which pair shows a predator-prey relationship between individuals?

00912R
L.III - 40%
D1 - 52%

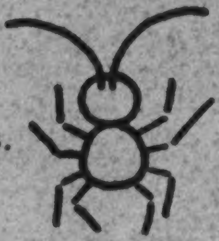
In which pair would the individuals be likely to show the most competition for food?

The diagrams represent the legs, antennae and body divisions of types of animals. Mouthparts are NOT shown. Use the diagrams to answer the questions following.

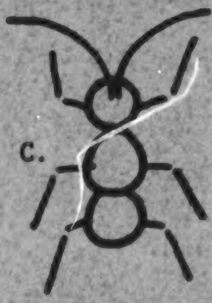
A.



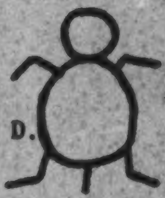
B.



C.



D.



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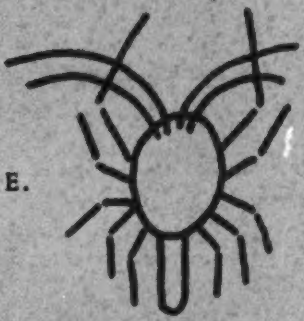

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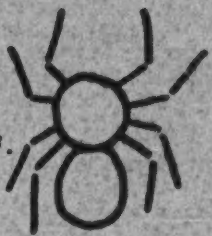

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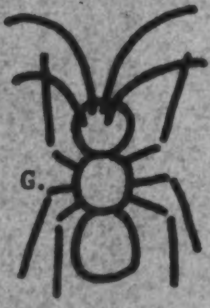


Choose the appropriate letter of the diagram which most probably belongs to each of the following classes:

00922C
L.III - 29%
D1 - 38%

Crustacea

00932N
L.III - NS
D1 - 51%

Insecta

00942Z
L.III - 19%
D1 - 25%

Reptilia

The following questions are based on the animals listed below.

planarian	*Hydra*	centipede	starfish	earthworm	spider
(i)	(ii)	(iii)	(iv)	(v)	(vi)

00952K
L.III - 42%
D1 - 54%

(i), (ii) and (iv) can be classified differently from the others on the basis of having

A. no segmentation.
B. radial symmetry.
C. an exoskeleton.
D. jointed appendages.

00961V
L.III - 62%
D1 - 47%

In which of the following pairs are the two organisms classified in the same phylum?

A. (i) and (ii)
B. (ii) and (iv)
C. (iii) and (v)
D. (iii) and (vi)

00971F
L.III - 27%
D1 - 49%

Which of the listed organisms have digestive systems with only one opening?

A. (i) and (ii) only.
B. (i) and (v) only.
C. (ii) and (iii) only.
D. (ii) and (v) only.

Use the table below to answer the following questions.

Organism	1	2	3	4	5	6
Order	Marsupalia	Carinatae	Marsupalia	Carnivora	Monotremata	Carnivora
Genus	Thylacinus	Troglodytes	Dasyurops	Felis	Ornithorhynchus	Felis
Species	cynocephalus	troglodytes	maculatus	tigris	anatinus	domesticus
Common Name	Tasmanian tiger	wren (bird)	tiger-cat	tiger	platypus	cat

00982T
L.III - 10%
D1 - 15%

Which two organisms below are most closely related?

A. 1 and 4
B. 1 and 3
C. 2 and 5
D. 4 and 6

00992D
L.III - 34%
D1 - 26%

Which two organisms below are most distantly related?

A. 2 and 5
B. 5 and 6
C. 1 and 5
D. 5 and 3

01002P
L.III - 21%
D1 - 40%

Which of the organisms belong to phylum Chordata?

A. all of them
B. all except 2
C. all except 5
D. all except 2 and 5

01012A
L.III - 22%
D1 - 32%

Which of the organisms belong to class Mammalia?

A. all of them
B. all except 2
C. all except 2 and 5
D. 2, 4 and 6 only

01022L
L.III - 12%
D1 - 19%

Which of these experimental procedures would serve best to determine the effectiveness of inoculating sheep against anthrax disease?

A. Expose 50 sheep to anthrax and then inoculate all of them.
B. Inoculate 25 out of 50 sheep and then expose all 50 to anthrax.
C. Inoculate 50 sheep and then expose all of them to anthrax.
D. Inoculate 25 out of 50 sheep and then expose only the 25 inoculated sheep to anthrax.

01032X
L.III - 47%
D1 - 47%

Which of the following comparisons between insect and wind pollinated flowers is not true?

	Wind pollinated flowers	Insect pollinated flowers
A.	flowers often colourless	flowers coloured
B.	pollen light and small	pollen heavier and sticky
C.	flowers odourless	flowers scented
D.	stigma small and simple	stigma large and feathery

01042H
L.III - 38%
D1 - 40%

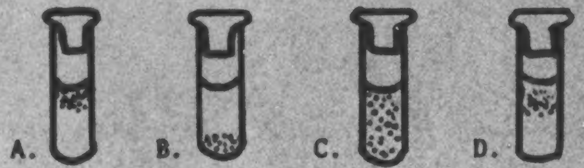
In the Christmas holly, some trees produce flowers which have only pistils and other trees produce flowers which have only stamens. Which would be planted to obtain branches that bear red berries?

A. "female" trees
B. "male" trees
C. both "female" and "male" trees
D. sterile trees

01052U
L.III - 13%
D1 - 30%

Most mammals have a constant body temperature of approximately 37°C. However the tip of the nose of a husky dog in the Arctic is approximately 5°C when the surrounding temperature is -30°C. Which of the following is the best explanation for this?

A. Huskies are exceptional mammals in that their body temperature is constant at approximately 5°C.
B. Chemoreception is improved by low temperatures.
C. In huskies, as in other dogs, a cold nose is a sign of good health.
D. The huskie's inner temperature is approximately 37°C but heat is lost rapidly from the body surface.



Study the diagram, which shows density of bacteria, represented by dark dots, growing in deep agar tubes. The medium is the same in each tube, but the bacteria are different species. The colonies are each at their optimum development stage.

01063F
L.III - 46%
D1 - 69%

Which tube contains an organism whose survival is most probably independent of oxygen concentration?

01073R
L.III - 58%
D1 - NS

Which tube contains an organism which is most probably an obligate aerobe?

01083C
L.III - NS
D1 - 72%

In which tube does the organism show the most limited tolerance for oxygen concentration?

01093N
L.III - 59%
D1 - 55%

A microbiologist wished to discover whether species A of bacteria produced an antibiotic which killed species B. The 2 species require similar nutrients. Of the following, his best experimental procedure would be to

A. grow species A in nutrient broth and add some of this broth to more broth in which B is to be grown.
B. grow species B on agar plates on which A had previously been growing.
C. grow species B and species A on the same plate and observe the distribution of colonies on the agar.
D. grow species A in nutrient broth and then grow species B in the same medium.

The following experimental results, 1,2,3,4, apply to the questions below.

1. Pasteur and his contemporaries found various microorganisms in animals and plants suffering from diseases.
2. When the myxoma virus was introduced into a population of rabbits most of them developed the disease myxomatosis.
3. A certain disease was cured by injecting into individuals suffering from it a substance which was known to kill microorganisms.
4. In a laboratory experiment all individuals injected with a certain virus developed symptoms of disease.

Which combination of results from the list above provides the best support for the following stated hypotheses?

01104A
L.III - 51%
D1 - 53%

The hypothesis "Diseases are caused by microorganisms" is supported by

A. 2 and 4 only.
B. 1, 3 and 4 only.
C. 1, 2, 3 and 4.
D. 1 and 2 only.

01114L
L.III - NS
D1 - 61%

The hypothesis "Symptoms of disease appear if the pathogen damages enough of the hosts' tissue to interfere with their normal functioning" is supported by

A. 1, 2 and 3 only.
B. 2 and 4 only.
C. 1, 3 and 4 only.
D. none of 1, 2, 3 or 4.

01124X
L.III - 48%
D1 - NS

The hypothesis "Healthy organisms may contain disease-causing pathogens" is supported by

A. 1, 2 and 4 only.
B. 2 only.
C. 3 and 4 only.
D. 1, 2, 3 and 4.

01151B
L.III - 29%
D1 - NS

If an amoeba were producing by splitting in half every thirty minutes, the maximum number of organisms that would result at the end of a two-hour period would be

A. 3.
B. 8.
C. 16.
D. 32.

01161M
L.III - NS
D1 - 38%

Animals which belong to the same order also belong to the same

A. family.
B. genus.
C. class.
D. species.

Interrelationships

10011G
L.III - 43%
D1 - NS

Which of the following is the best definition of a predator?

A. an animal which kills and eats other animals
B. an animal which lives at the expense of another organism
C. an organism which causes the death of an animal
D. an organism which consumes other organisms

10021T
L.III - 13%
D1 - 22%

Relatively few "warm blooded" animals are found living in water. Warm bloodedness is probably a greater advantage to a land-living animal than to an aquatic animal because

A. air temperatures fluctuate more widely than water temperatures.
B. air temperatures are generally higher than water temperatures.
C. land-living animals can grow to a greater size than water-living animals.
D. few water-living animals require blood.

10031D
L.III - 26%
D1 - 22%

Which of the following living vertebrates is found in the greatest variety of habitats?

A. amphibians
B. reptiles
C. bony fish
D. mammals

10041P
L.III - 52%
D1 - NS

Kwashiorkor is a protein deficiency disease. You would expect to find as characteristic of the disease

A. stunted growth of children.
B. changes in the colour and texture of hair.
C. fluid accumulation in the abdomen and ankles.
D. all of the above.

10051A
L.III - 21%
D1 - 45%

Of the following things, for photosynthesis, a living green plant does not require

A. water.
B. light.
C. oxygen.
D. carbon dioxide.

10061L
L.III - 62%
D1 - 72%

Which of the following features is most likely to be present in an angiosperm which lives submerged in water?

A. a thick stem
B. thin leaves
C. an extensive root system
D. conspicuous flowers

10071X
L.III - 11%
D1 - 26%

Plants showing features likely to reduce excessive water loss (as in the dry parts of Australia) are likely to

A. be trees or shrubs.
B. have flowers of the same form.
C. have thick bark.
D. have rolled leaves and sunken stomata.

10081H
L.III - 82%
D1 - 76%

All of the following may be found in the zooplankton "population" of a fresh water pond except

A. *Cyclops*.
B. *Daphnia*.
C. *Spirogyra*.
D. *Paramecium*.

10091U
L.III - NS
D1 - 48%

In any community the greatest amount of energy absorption and storage is found in the

A. producer organisms.
B. first order consumers.
C. highest order consumers.
D. largest carnivores.

10101E
L.III - 52%
D1 - NS

Which one of the following characteristics is revealed by careful studies of communities in nature?

A. Changes occur within the community according to a definite pattern.
B. Changes within the community occur at a fairly fixed rate.
C. Communities remain unchanged indefinitely.
D. The changes within a community are quite independent of the organisms within the community.

10111Q
L.III - 26%
D1 - 23%

Aquatic mammals are able to develop to a much greater size than land mammals. The reason for this is most likely to be that

A. the buoyancy of the water helps to support the animal's weight.
B. the temperature of the water fluctuates less than that of the air.
C. there is a more plentiful supply of food.
D. there are fewer predators.

10121B
L.III - 18%
D1 - 21%

From an evolutionary point of view, the best adapted parasite is one which

A. causes rapid death of the host.
B. produces a mild disease in the host.
C. produces a long illness in the host before killing it.
D. has little effect on the host.

10132N
L.III - 45%
D1 - 46%

Of the following, the least important advantage that fish gain from being streamlined in shape is that

A. this gives them a larger surface area for respiration.
B. they are able to move with little effort.
C. they can more easily escape their predators.

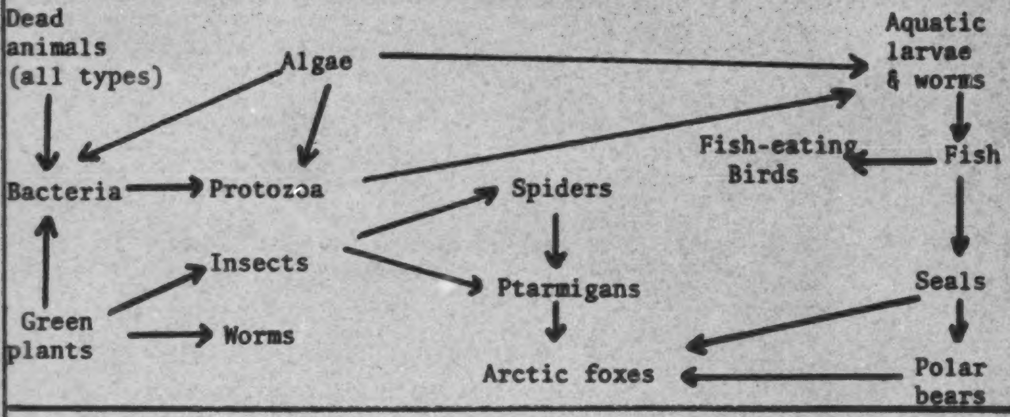
10142Z
L.III - NS
D1 - 14%

When organisms live densely packed in a small area they are more likely to compete if they belong to one species than if they belong to many different species, because individuals of one species

A. have similar requirements.
B. have similar mortality rates.
C. can produce fertile offspring.
D. are less likely to emigrate.

Data for questions below

The relationships of certain organisms of Arctic regions are shown below:


Dead animals (all types)
Algae
Aquatic larvae & worms
Bacteria
Protozoa
Fish-eating Birds
Fish
Spiders
Insects
Ptarmigans
Seals
Green plants
Worms
Arctic foxes
Polar bears

10152K
L.III - 15%
D1 - 28%

The series - green plants, insects, ptarmigans, arctic foxes - represents

A. a succession.
B. a dynamic equilibrium.
C. an energy cycle.
D. a food web.
E. a food chain.

10162W
L.III - 31%
D1 - 32%

The diagram is an example of

A. an energy cycle.
B. a food web.
C. an environmental interaction chart.
D. an ecosystem.

10172G
L.III - 15%
D1 - NS

Of the following, the ptarmigan would most likely be

A. an insect.
B. a snail.
C. a green plant.
D. a bird.

10182T
L.III - 55%
D1 - 56%

Of the following, the organism found in the smallest numbers would most probably be the

A. spiders.
B. ptarmigans.
C. insects.
D. worms.
E. green plants.

10192D
L.III - 13%
D1 - 18%

If hunters killed many of the seals in the area, it would be expected that, as a consequence, there would be an increase in the numbers of

A. polar bears.
B. arctic foxes.
C. fish-eating birds.
D. algae.

10202P
L.III - 16%
D1 - 22%

Which of the following statements does not apply to both a food chain and a food web?

A. It involves organisms living in a community.
B. Each organism depends for its survival on only one other organism.
C. It involves the transfer of energy from one organism to another.
D. The energy being transferred came originally from the sun.

10212A
L.III - NS
D1 - 40%

Which of the following pairs of organisms is most likely to be found in a land environment that is moist, cool, shady, and contains humus soil?

A. liverworts and echinoderms
B. mosses and amphibians
C. algae and sponges
D. sheoak and reptiles

10222L
L.III - 56%
D1 - NS

Oats and lucerne were grown under similar conditions in nitrogen deficient soil. The lucerne produced a healthy crop but the oats produced very straggly plants. The most probable explanation is that

A. lucerne does not need nitrogen for growth.
B. lucerne can use other minerals in place of nitrogen.
C. lucerne seeds store enough nitrogen for prolonged growth.
D. lucerne can obtain nitrogen other than from the soil.

The following questions are concerned with the paragraph below.

> It is thought that when the hydatid worm first infected the dog, the dog had little chance of survival. This was bad for the chances of survival of the worm. Hence over a period of time, the worm was able to live in the dog without killing it. The dog lived to spread the infection further.

10232C
L.III - 18%
D1 - 20%

This is an example of

A. collaboration.
B. adaptation.
C. lack of resistance of the dog to infection.
D. diversity.

10242H
L.III - 55%
D1 - 62%

The process described in the paragraph can only occur if

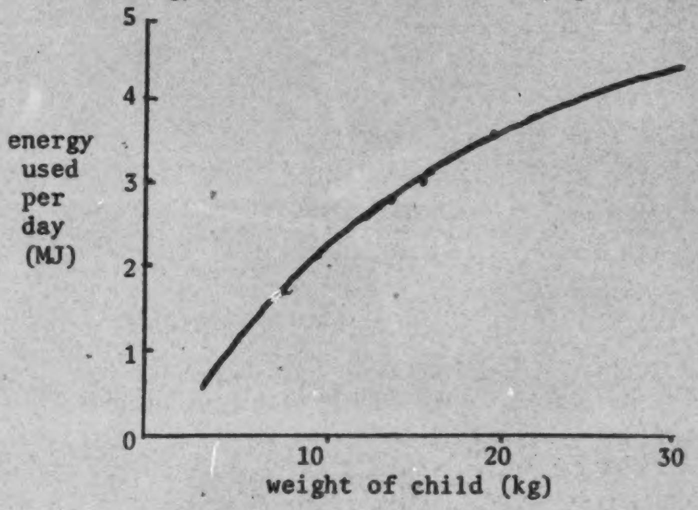
A. the fittest or best adapted will survive.
B. the dog eats more food.
C. the worm uses food not used by the dog.
D. the life cycle of the worm changes.

10252U
L.III - 21%
D1 - 45%

The breakdown of sewage by bacteria in a river produces a high concentration of nutrients - a process called eutrophication - and this frequently leads to increased growth by producer organisms. However, the subsequently increased mass of consumers generally die. The best reason for the dying is that, for the consumers,

A. there is too much food.
B. there are too many nutrients.
C. there is too much carbon dioxide.
D. there is too little oxygen.

The graph shows measurements made of the average amount of basal energy used by children as they grow.



10262E
L.III - 73%
D1 - 83%

From this data, the energy needed per kilogram of body weight for a 15 kilogram child is most likely to be

A. 15 megajoules.
B. 3 megajoules.
C. 2 megajoules.

10272Q
L.III - 14%
D1 - NS

The ecological relationship between the members of one of the following pairs of organisms is different from that of the other three pairs. Which is the pair with the different relationship?

A. hawk - mouse
B. snake - frog
C. horse - donkey
D. horse - grass

10282B
L.III - 31%
D1 - 35%

Rabbits in the laboratory are able to breed throughout the year and are capable of producing up to seven litters a year, but studies of the wild rabbit of South Australia show that no more than five litters a year are produced, mostly in the winter and summer months. The most likely reason for this is that

A. the climate of South Australia is totally unlike the climate to which they were originally adapted.
B. rabbits need not produce more than 5 litters in order to maintain their numbers.
C. rabbits breed only when food is plentiful.
D. in the wild the number produced tends to be approximately equal to the number killed by predators.

The following table shows the amount of water produced as a result of the breakdown of 1 gram of each of the food classes listed:

food class	water produced (g)
carbohydrate	0.6
fat	1.1
protein	0.3

10292M
L.III - 31%
D1 - 33%

The kangaroo rat is an animal which survives on a diet of dry food. It does not normally drink. It is least likely to be able to exist without drinking if it lived on a diet which is

A. high in carbohydrates.
B. high in fats.
C. high in protein.
D. composed of succulent leaves.

10442A
L.III - 50%
D1 - 42%

Plants with light coloured leaves (e.g. bluish and waxy or shiny silver) would be expected to be found growing in

A. high wind velocities.
B. high humidities.
C. high light intensities.
D. low temperatures.

Studies have shown that some cows can bite up to 36 000 times a day while grazing. But if these cows take less than 0.3 g of organic matter with each bite, they do not get enough food to satisfy their needs. It was suspected that the actual shape of some tropical grasses might limit feed intake. An experiment designed to test this gave the following result:

Appearance of tropical grass	Amount of organic matter per bite (mg)
sparse - about 5 cm high	100 - 200
thick - about 30 cm high	300 - 600
mature - about 60 cm high	50 - 150

Cows were also grazed on 2,4,6 and 8 week old regrowth - four week old regrowth allowed the biggest bite sizes, but bite sizes fell off rapidly for 6 or 8 week regrowth, and on 8 week regrowth cows averaged only 0.15 g of organic matter per bite. Studies of the structures of tropical grasses show that compared with temperate grasses they are usually well endowed with leaf, but generally open and their leaves not packed together. The bottom 30 cm of the tropical pastures contain more bulk and more leaf, but the cows could not easily reach these nutritious leaves.

10302Y
L.III - 36%
D1 - 60%

Which of the following best sums up the experiment?

A. The tallest grasses provide the best feed for the cattle.
B. Tropical grasses are not as nutritional as temperate grasses.
C. Young grasses have a higher organic content than older grasses.
D. Tropical grasses have a definite optimum height, above which cattle cannot use them efficiently.

10312J
L.III - 46%
D1 - 43%

From the given data it appears that temperate grasses are better feed for cattle than tropical grasses because

A. tropical grasses contain a lower amount of organic matter.
B. cattle can graze temperate grasses more efficiently than tropical grasses.
C. temperate grasses contain more leaf matter.
D. temperate grasses are more open enabling cattle to reach their leaves.

10322V
L.III - 29%
D1 - NS

What would be the probable result of grazing cattle on pastures from which their intake of organic material per bite was less than 300 mg?

A. The cattle would increase the number of bites per day above 36 000.
B. The grass would be very closely grazed.
C. The cattle would be unable to maintain a constant body weight.
D. The cattle would take larger mouthfuls.

10332F
L.III - 14%
D1 - 21%

If a cow had its food needs satisfied while taking less than 20 000 bites per day it could be concluded that

A. it was feeding on temperate grasses.
B. it was feeding on mature tropical grasses.
C. the amount of organic material per bite must be greater than 300 mg.
D. the amount of organic material per bite must be less than 300 mg.

In a number of surveys of seedling survival in a forest community, the data in the following tables was obtained:

Table 1: Ages of Seedlings Damaged by Browsing Animals

DATE	Age of Seedlings		
	Less than 2 years	2-4 years	4-10 years
April, 1963	5	9	-
June, 1963	1	2	-
September, 1963	-	3	-
December, 1963	4	4	1
March, 1964	12	20	2
June, 1964	1	3	-
September, 1964	2	1	-
TOTAL	25	42	3

Table 2: Ages of Seedlings Dying from Lack of Water

DATE	Age of Seedlings		
	Less than 2 years	2-4 years	4-10 years
April, 1963	4	7	1
June, 1963	1	1	-
September, 1963	-	-	-
December, 1963	-	-	-
March, 1964	-	1	-
June, 1964	8	8	1
TOTAL	13	17	2

Data was also collected on the effect of leaf litter on seedlings as shown in the following table:

Table 3: Fates of Seedlings Covered by Leaf Litter

CONDITION	Age of Seedlings		
	Less than 2 years	2-4 years	4-10 years
Dead	17	5	(too tall to be covered)
Alive, but pale and spindly	2	1	
Alive, but no new shoots	0	1	
Healthy, with new shoots	2	3	
TOTAL	21	10	0

Using the information in the above tables answer the following questions:

10342R
L.III - 12%
D1 - 21%

In which age class are plants most susceptible to lack of water?

A. less than 2 years
B. 2-4 years
C. 4-10 years

10352C
L.III - 12%
D1 - 18%

In which age class are plants least susceptible to lack of water?

A. less than 2 years
B. 2-4 years
C. 4-10 years

10362N
L.III - NS
D1 - 10%

In which age class are plants probably most affected by lack of light?

A. less than 2 years
B. 2-4 years
C. 4-10 years

10372Z
L.III - 14%
D1 - 9%

In which age class are plants probably least affected by lack of light?

A. less than 2 years
B. 2-4 years
C. 4-10 years

10382K
L.III - NS
D1 - 10%

From the tables it appears that older plants have a better chance of surviving than younger ones because

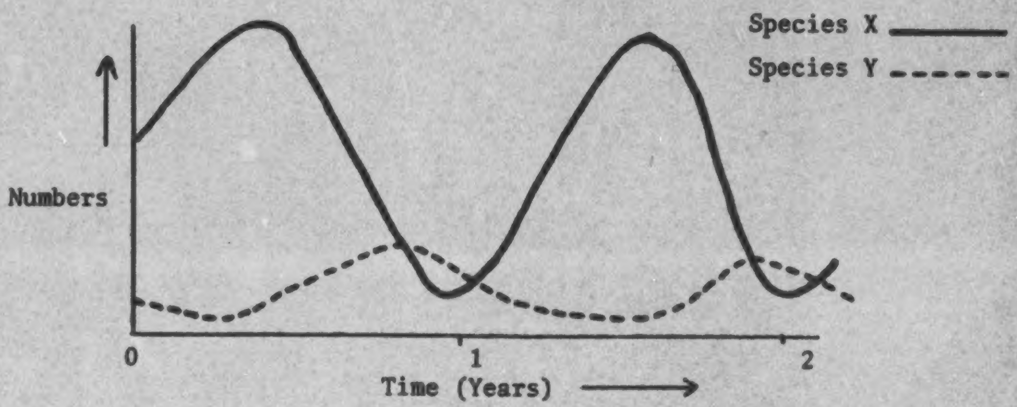
A. they are less affected by lack of water.
B. they are not affected by covering by leaf litter.
C. they are less affected by damage by browsing animals.
D. all of the above are true.

10392W
L.III - 15%
D1 - 10%

From the tables it appears that the presence of adult trees around seedlings may influence their chances of survival by

A. covering them with leaf litter.
B. utilizing their water supply.
C. limiting the amount of light they receive.
D. all of the above factors.

The graph below shows the change in population of two species, over a period of two years.



Use this graph to answer the following questions.

10402G
L.III - 74%
D1 - 64%

What is the most likely relationship between 'X' and 'Y', in order?

A. producer - consumer
B. carnivore - herbivore
C. predator - prey
D. mutualism

10412T
L.III - NS
D1 - 42%

If a third species (species 'Z') was introduced, and it was found that this species preyed upon species 'Y', what would be the most likely immediate effects on the community?

A. Species 'X' would increase and species 'Y' and 'Z' would decrease.
B. Species 'Y' and 'Z' would increase and species 'X' would decrease.
C. Species 'Y' would increase and species 'X' and 'Z' would decrease.
D. Species 'X' and 'Z' would increase and species 'Y' would decrease.

10592N
L.III - 42%
D1 - NS

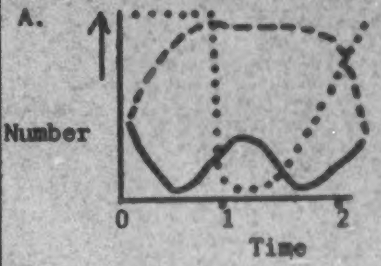
Assume species 'X' is an autotroph and species 'Y' feeds on it exclusively; then species 'X' would be

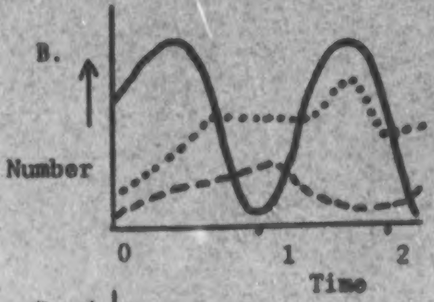
A. an omnivore.
B. a carnivore.
C. a herbivore.
D. a plant.

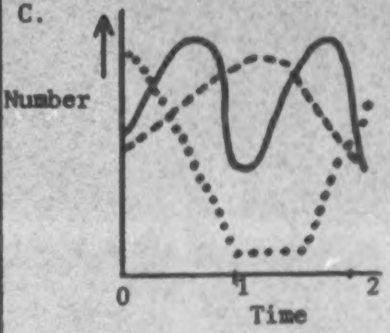
10422D
L.III - 60%
D1 - 59%

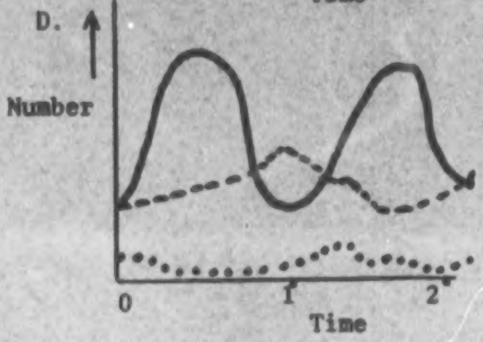
Assuming there were only these three species mentioned living in the community, which graph would best predict what would happen to the community over the next two years?

Assume species X is an autotroph.
Assume species Y is a first order heterotroph.
Assume species Z is a carnivore.









Species X ————
Species Y - - - - - - - -
Species Z • • • • • • • •

10432P
L.III - 25%
D1 - 26%

Which of the following groups of organisms is most likely to fit the descriptions of species X, Y and Z, indicated in the questions above?

A. grass, fox, hawk
B. grass, rabbit, fox
C. rabbit, hawk, fox
D. sunlight, grass, rabbit

10452L
L.III - 23%
D1 - 23%

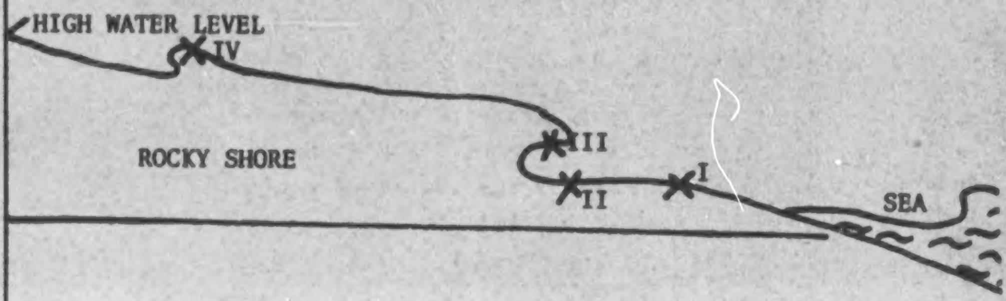
A marine sponge was crushed by a boulder which fell from the cliff above. The sponge was fragmented into at least seven separate pieces. Four days later five new sponges were growing where the crushed sponge had been. The most likely explanation is that

A. other sponges were attracted to the area by the fluids of the crushed sponge.
B. the crushed sponge fragments regenerated into five new organisms.
C. the five sponges had gathered to consume the liberated nutrients of the crushed sponge.
D. the crushed sponge liberated fertilized eggs as the boulder crushed it.
E. the five new sponges grew there quickly because the area had already been colonised.

The small periwinkle inhabits exposed rocky shores around the high water level. The behaviours listed in the key (A-D) explain how a displaced periwinkle eventually finds its way back to the high water level.

A. It moves upwards only so long as it is wet.
B. If dry it remains motionless.
C. It normally moves away from light.
D. If it is upside down it seeks light.

For each of the following three questions (which refer to points labelled in the diagram), choose the behaviour which allows the periwinkle to continue its journey towards the high water level.



10462X
L.III - 20%
D1 - 21%

Point I

10472H
L.III - 42%
D1 - 38%

Point II

10482U
L.III - 26%
D1 25%

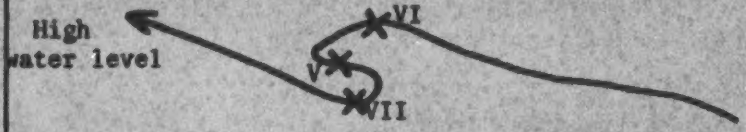
Point III

10492B
L.III - 12%
D1 - 8%

If point IV was subject to a hot, land wind, which behaviour would be followed by the periwinkle?

10502Q
L.III - 69%
D1 - 85%

Suppose the periwinkle finds itself in the situation at point V below. All points marked are "wet".



Assuming the only behaviours are those listed in the key, what is the periwinkle most likely to do?

A. Continue to point VII and then stop.
B. Continue right to the high water level.
C. Go back to point VI and then stop.
D. Stay at point V.
E. Move between points V and VI several times.
F. Move between points V and VII several times.

10512B
L.III - 22%
D1 - 34%

If a live salt-water crayfish is put into a tub of fresh water it will die because

A. there is less oxygen in fresh water than in salt water.
B. salt-water animals cannot live in fresh water.
C. the pressure of water in its body cells increases.

Cellulose tubing used in the following experiment was permeable to monosaccharides but not to polysaccharides. Into a tube made of this material a student poured a concentrated solution of starch and placed it in a beaker of water (Beaker A) to which he added a drop of iodine. He then took another tube into which he poured a glucose solution and this tube was placed in a beaker of water (Beaker B) to which he also added a drop of iodine. These were then left overnight.

10522M
L.III - 79%
D1 - 67%

Where would it be expected that a blue-black colour would be found?

A. in the beaker A but not in the tube of starch solution
B. in the tube of starch solution and in beaker A
C. in the tube of starch solution but not in beaker A
D. in the tubes of both starch and glucose
E. in both beaker A and beaker B
F. in the tube of glucose and beaker B

10532Y
L.III - 70%
D1 - 66%

The level of water in beaker A would

A. fluctuate in some unpredictable way.
B. remain the same.
C. become higher.
D. become lower.

10542J
L.III - 52%
D1 - 51%

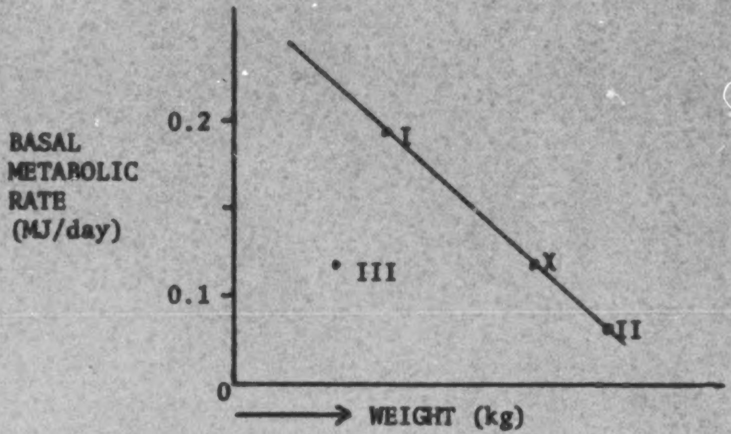
If at the end of the experiment the student tested the solutions in the tube of glucose and in the beaker B for sugar by using testape he would expect to find

A. a positive result in the tube but not in the beaker.
B. a positive result in both the tube and the beaker.
C. a positive result in the beaker but not the tube.
D. no positive result.

10552V
L.III - 57%
D1 - 49%

The experiment would demonstrate

A. osmosis only.
B. diffusion only.
C. both osmosis and diffusion.
D. neither osmosis nor diffusion.



10562F
L.III - NS
D1 -62%

The graph shows the relationship between basal metabolic rate and the body weight of an organism - in this case man. The point X represents the basal metabolic rate of an average adult male. If you were to transfer the data for a child to the same graph, you would expect the position to be at

A. point I on the graph.
B. point II on the graph.
C. the same position as X.
D. point III on the graph.

10573T
L.III - 74%
D1 - 79%

Which of the following comparisons between a freshwater fish and a marine fish is not correct?

	Freshwater fish	Marine fish
A.	produces little urine	produces large amounts of urine
B.	water tends to enter its body	water tends to leave its body
C.	drinks little water	drinks copiously
D.	does not excrete salt	excretes salt

10584E
L.III - 48%
D1 - 50%

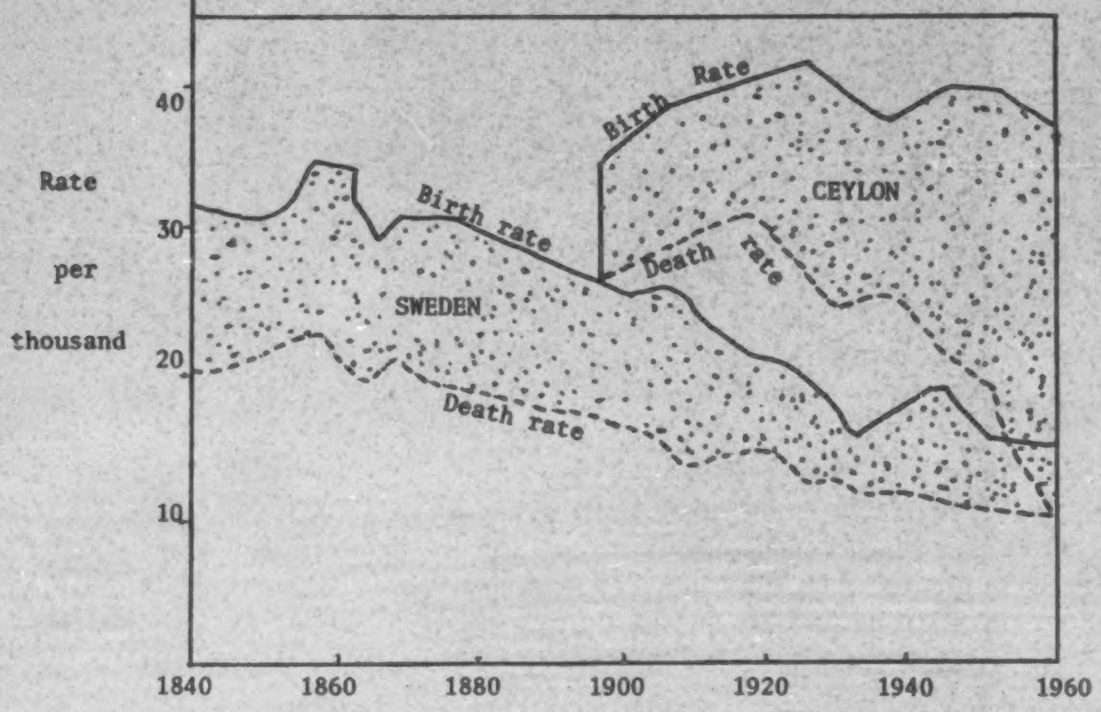
Eucalypt seedlings proliferate after a bush fire following the fall of seed from burnt trees, but only a few survive to maturity. Isolated eucalypt seedlings have also been found in fern gulleys but never survive to maturity.

The most likely reason for the above findings is that

A. browsing animals consume eucalypts at an early stage.
B. animals eat most of the seeds.
C. fern gulleys are too wet for eucalypt growth.
D. eucalypt seedlings require a minimum level of light to survive.

Change

Use the graph below to answer the following question.



Birth rate (solid line) and death rate (broken line) for Sweden and Ceylon. The shaded area represents the growth of the populations, ignoring emigration and immigration.

20012C
L.III - 41%
D1 - NS

In which of the following years were the growth rates of the two countries approximately equal?

A. 1840
B. 1900
C. 1940
D. 1960

20022N
L.III - 48%
D1 - 54%

If the birth-rate is represented by the letter 'B', the death-rate by the letter 'D', immigration rate by the letter 'I' and emigration rate by the letter 'E', which of the following formulae would give the rate of change of a population in a particular community?

A. (B - E) + (I - D)
B. (B + I) - (D - E)
C. D + E + B - I
D. (B + I) - (E - D)

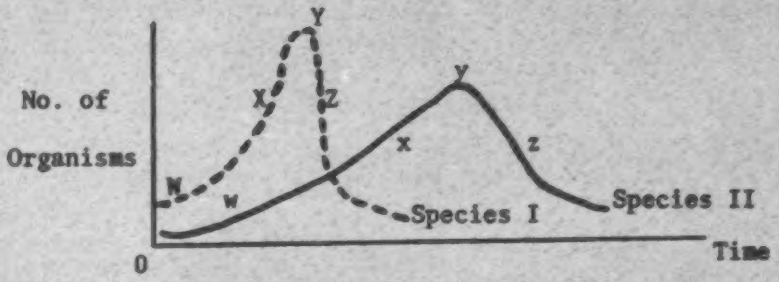
20032Z
L.III - 21%
D1 - 37%

Although Madagascar is separated from Africa only by a strait some 80 miles wide, many plants and animals common on the mainland are unknown on the island. This fact illustrates the principle of

A. great environmental differences between Africa and Madagascar.
B. evolutionary equilibrium.
C. evolution in isolated populations.
D. succession.

The following information applies to the questions below:

Two species of aerobic bacteria with the same nutritional requirements were cultured together in a flask in a well aerated medium. The population curves for the two species are shown on the graph.



20042K
L.III - 28%
D1 - 49%

At which points in each of the population curves is there an approximate balancing of the reproductive rate by death rate?

A. W, w
B. X, x
C. Y, y
D. Z, z

20052W
L.III - 35%
D1 - 60%

Near which points does maximum rate of growth occur for the two species?

A. W, w
B. X, x
C. Y, y
D. Z, z

20062G
L.III - NS
D1 - 63%

Which statement provides the best explanation for the slowing down of the bacterial growth rate of species I after X?

A. an increase in available oxygen
B. a decrease in waste materials present
C. a decrease in nutrient supply
D. an increase in toxic waste

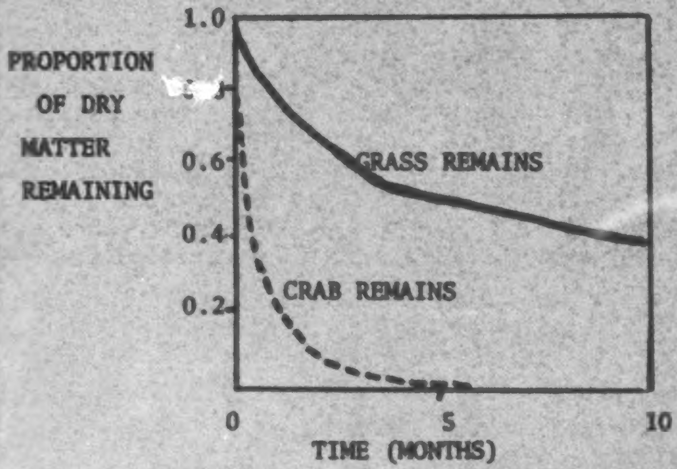
20072T
L.III - 49%
D1 - 63%

Species I shows a large decline at Z in the number of viable bacteria. The most likely explanation for this decline is that the

A. food supply became exhausted.
B. secretions from species II were toxic to species I.
C. supply of oxygen decreased and CO_2 increased.
D. species I dehydrated the contents of the flask during its metabolic processes.

The questions below are based on the following information:

In experiments conducted on an American coastal marsh scientists compared the rates at which dead plant and animal material were consumed. (See graph below)



They enclosed animal remains (dead crabs) and plant remains (grass) in plastic mesh bags and buried them in the mud where they were exposed to the activities of organisms.

20082D
L.III - 45%
D1 - 56%

The best reason for the grass decomposing more slowly than the crab is that

A. the grass contained more water than the crabs.
B. the grass was made up of organic material which was different from the crabs.
C. decay bacteria were able to decompose crabs but not grass.
D. fungi were able to decompose the crabs but not the grass.

20092P
L.III - 40%
D1 - 48%

The best reason why plastic mesh bags were used was that

A. plastic does not get wet and therefore dry weight could be easily determined.
B. plastic mesh decomposes very little and so the solid would be easily retained.
C. plastic mesh is easily recoverable from a swamp.
D. plastic mesh would prevent water and inorganic salts escaping.

20102A
L.III - NS
D1 - 40%

The best reason for determining dry weight was that

A. the weight contribution of the mass of bacteria would be ignored.
B. water in the crabs weighs more than water in the grass.
C. the cells of the different organisms could contain different weights of water.
D. drying out the organisms at intervals hastens decomposition and therefore results could be obtained more quickly.

This paragraph from Scientific American, August 1973, should be used to answer the following questions:

> Severe reduction in the population of large baleen whales following the introduction of factory ships and fleets of catchers to Antarctic waters after World War II has affected the ocean ecosystem of the region. An oceanographer calculates that before intensive whaling began the large whales annually consumed 150 million tons of krill, the shrimp-like animals that are their principal food. As the biomass represented by the large whales dwindled from 33 million tons to 5 million, the biomass of "surplus" krill increased correspondingly. The beneficiaries of the increase are krill-eating birds, fishes and squid of the region.

20112L
L.III - 42%
D1 - 48%

The factory ships and fleets of catchers are well characterized by one of the following biological niches. Which one is it?

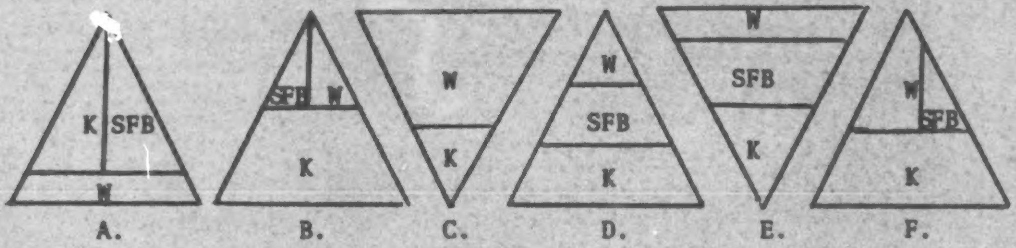
A. prey
B. scavenger
C. secondary consumer
D. primary consumer

20122X
L.III - 13%
D1 - 18%

Which of the following is a definite result of the decrease in the biomass of the whales?

A. The krill biomass increased.
B. The overall biomass decreased.
C. The biomass of the krill decreased.
D. The biomass of the fleet decreased.

Use the following diagrams in addition to the above paragraph to answer the questions below:



SFB = squid, fish and birds
W = whales
K = krill

20132H
L.III - 51%
D1 - 61%

Which diagram best describes the situation in the ocean ecosystem before World War II?

20142U
L.III - 55%
D1 - 61%

Which diagram best describes the ocean ecosystem now?

The overall rate of change of a population r may be expressed as follows:

$$r = (b + i) - (d + e).$$

where b = birth rate
d = death rate
e = emigration rate
i = immigration rate

In 1938 with a population of 6 936 000 Australia had a birth rate of 17.38 per thousand individuals, a death rate of 9.59, an immigration rate of 2.82 and an emigration rate of 1.65.

20152E
L.III - NS
D1 - 61%

Approximately how many individuals should there have been in Australia by 1939?

A. 8 000 000
B. 7 000 000
C. 5 840 112
D. 58 401 120

20162Q
L.III - 22%
D1 - 24%

The corresponding figures for 1958 per thousand individuals were $b = 22.36$, $d = 8.41$, $e = 4.52$, $i = 11.04$.

The rate of population growth in 1958 compared with 1938

A. increased.
B. decreased.
C. remained the same.
D. cannot be worked out with the data given.

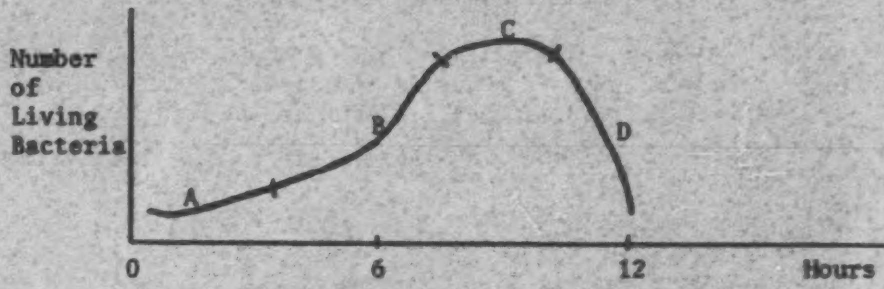
20172B
L.III - 28%
D1 - NS

The most likely reason for the increase in 'e' in 1958 as compared with 1938 is that

A. Australia was becoming spoiled and overpopulated and therefore people left.
B. economic conditions facilitated the movement of Australians to other countries.
C. Australians got better salaries working abroad.
D. the government's immigration policy caused people to leave.

The questions below are based on the following situation:

A single aerobic bacterium was added to a flask containing food, moisture and oxygen. The flask was sealed and maintained in the dark at a temperature of 34°C. Optimal conditions for the growth of bacteria existed in the flask when it was sealed. The curve below represents the growth of the bacteria in the flask. The stages are marked by letters.



20182M
L.III - NS
D1 - 15%

Which of the following could account for the slowing down of the rate of growth at the beginning of period C?

A. an increase in the amount of food available
B. an increase in the amount of oxygen present
C. a decrease in the amount of waste materials present
D. a decrease in the amount of oxygen available

20192Y
L.III - NS
D1 - 21%

In which stage is the production of new bacteria balanced by the death of the old bacteria?

20202J
L.III - NS
D1 - 37%

If the conditions existing during period C could be maintained for a considerable period of time, the number of living bacteria

A. would increase again.
B. would remain about the same.
C. would decrease.
D. could not be predicted.

20212V
L.III - 71%
D1 - NS

Which of the following would most likely be responsible for the colonization of a fairly isolated island by lizards?

A. lizard eggs carried on the legs of birds
B. lizards on debris floating in the sea
C. lizards swimming to the island
D. lizard eggs blown by the wind

20222F
L.III - 42%
D1 - 35%

Fossil evidence shows that populations of the Tasmanian devil, a carnivorous marsupial, once lived on the Australian continent. They became extinct on the mainland about 2000 years ago and now live only in Tasmania, where they flourish to the extent of being a pest in some farming areas. Which of the following is the most likely reason for the devil dying out in mainland Australia?

A. They were not adapted to the hotter climate on the mainland but were successful in the cooler Tasmanian climate.
B. They died from lack of suitable food.
C. They could not compete successfully with more efficient carnivores such as dingoes.
D. They were exterminated by hunting Aboriginals.

20234U
L.III - 76%
D1 - 79%

Adult flounders live on sandy sea-beds; they have two eyes, but both are on the same side of the body. Which of the following best describes the probable origin of this adaptation?

A. The animals live on the sand, and eyes on both sides of the head are not needed.
B. Over a long period of time, some mutant flounders had eye positions which were not symmetrical, and ones with both eyes on top survived in greater numbers than the others.
C. The eye on the sandy side was not needed, and disuse in the dark caused the eye to rotate towards the light in the embryonic forms.
D. Evolution caused the position of the eye to change so that the flounder was best suited to its environment.

Living World

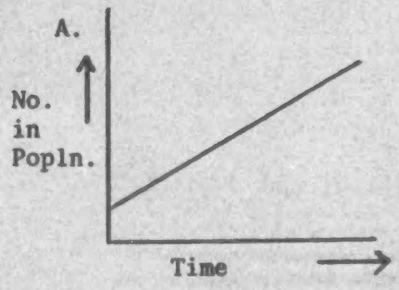
30011W
L.III - 61%
D1 - 60%

Which of the following organisms would respire most food per gram of body weight?

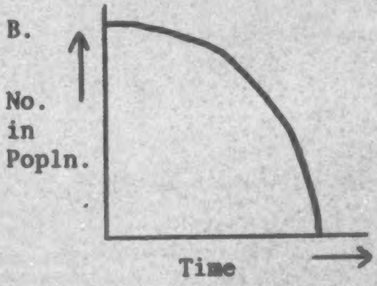
A. an earthworm
B. a flowering plant
C. a sparrow
D. a mould

The graphs below represent changes in the size of different populations over a period of time. The scales on all the graphs are linear.

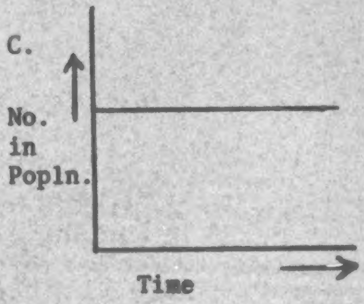
A.



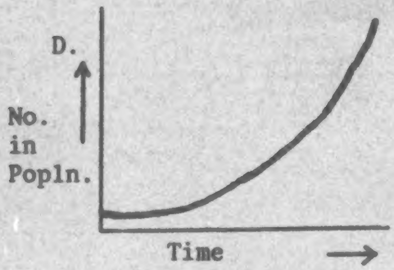
B.



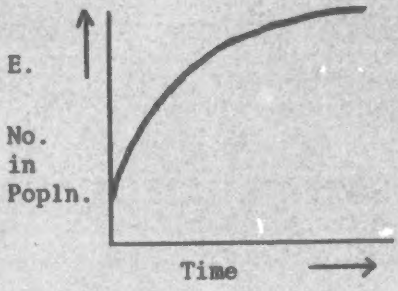
C.



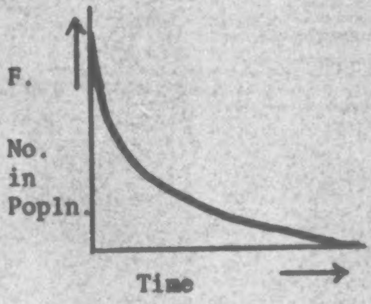
D.



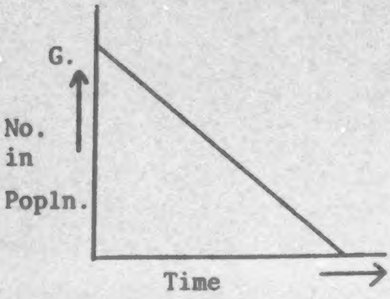
E.



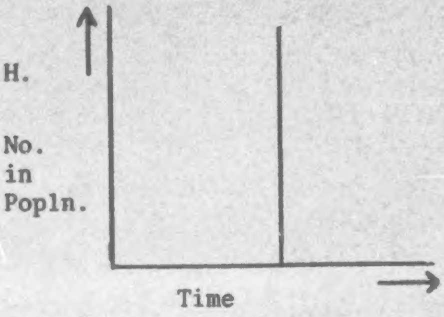
F.



G.



H.



Which graph best represents each of the following?

30022H
L.III - 23%
D1 - 34%

a rising rate of increase in a growing population

30032U
L.III - 37%
D1 - 48%

a falling rate of increase in a growing population

30042E
L.III - 83%
D1 - NS

a falling rate of decrease in a growing population

30052Q
L.III - 50%
D1 - 63%

an accelerating rate of decline in a declining population

30062B
L.III - 15%
D1 - 28%

a steady rate of increase in a growing population

30072M
L.III - 35%
D1 - 49%

a decelerating rate of growth in a growing population

30082U
L.III - 36%
D1 - 34%

a steady rate of decrease in a declining population

30092J
L.III - 19%
D1 - 36%

the general trend of the human population over the last thousand years

30102V
L.III - 33%
D1 - 45%

a population in which there is an equal birth rate and death rate, no emigration and there is a constant immigration rate

30112F
L.III - 40%
D1 - 49%

a population in which there are no births, no deaths, no immigration rate and constant emigration rate

30122R
L.III - 27%
D1 - 37%

spontaneous generation

The following information applies to the questions below:

> A stand of eucalypts on a sheltered hillside has living within it various species of mosses and lichens, several species of invertebrates, and is the nesting place for a flock of birds all of the same species.

30132C
L.III - 25%
D1 - 44%

This group of organisms constitutes

A. a habitat.
B. a community.
C. a population.
D. an ecosystem.

30142N
L.III - 36%
D1 - 47%

The flock of birds represents

A. a population.
B. a community.
C. a family.
D. none of these.

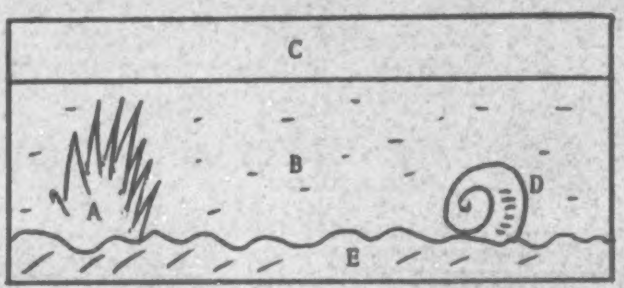
30152Z
L.III - 40%
D1 - 47%

If a food chain were to be constructed of the organisms mentioned, which of the following would be the highest order consumer?

A. a bird which eats sapsucking insects from the tree
B. an aphid which feeds on the sap of the tree
C. a louse which feeds on the bird
D. the fungal component of the lichen

The following data relates to the questions below:

The figure below represents a sealed aquarium which is exposed to light and kept at a fairly constant temperature. In the figure, C represents enclosed air above the water, B the water, D the animal life in the water, A the plant life, and E the soil at the bottom. At the time it was sealed, the aquarium contained a balance of plant and animal life. Answer the questions on the basis of the information given above.



30162K
L.III - 27%
D1 - 32%

How long will it be most likely for life to continue in the aquarium?

A. until the original oxygen supply in the air above the water is used, but not longer
B. until the original supply of O_2 dissolved in the water has been used up, but not longer
C. at most, not more than two months
D. until the original supply of nitrogen in the soil at the bottom is used up, but no longer
E. indefinitely, as long as light shines regularly on the aquarium and the temperature stays above freezing

30172W
L.III - 30%
D1 - 49%

Where within the aquarium does energy enter the energy cycle?

30182G
L.III - 8%
D1 - 24%

Where within the aquarium is the oxygen supply replenished?

30192T
L.III - 58%
D1 - 56%

Where is carbon dioxide produced as a waste product?

A. A only
B. A and D
C. B and D
D. A and B
E. D only

30202D
L.III - 24%
D1 - 32%

Where is carbon dioxide utilized as a raw material?

A. A and B
B. B and D
C. A only
D. D only
E. A and D

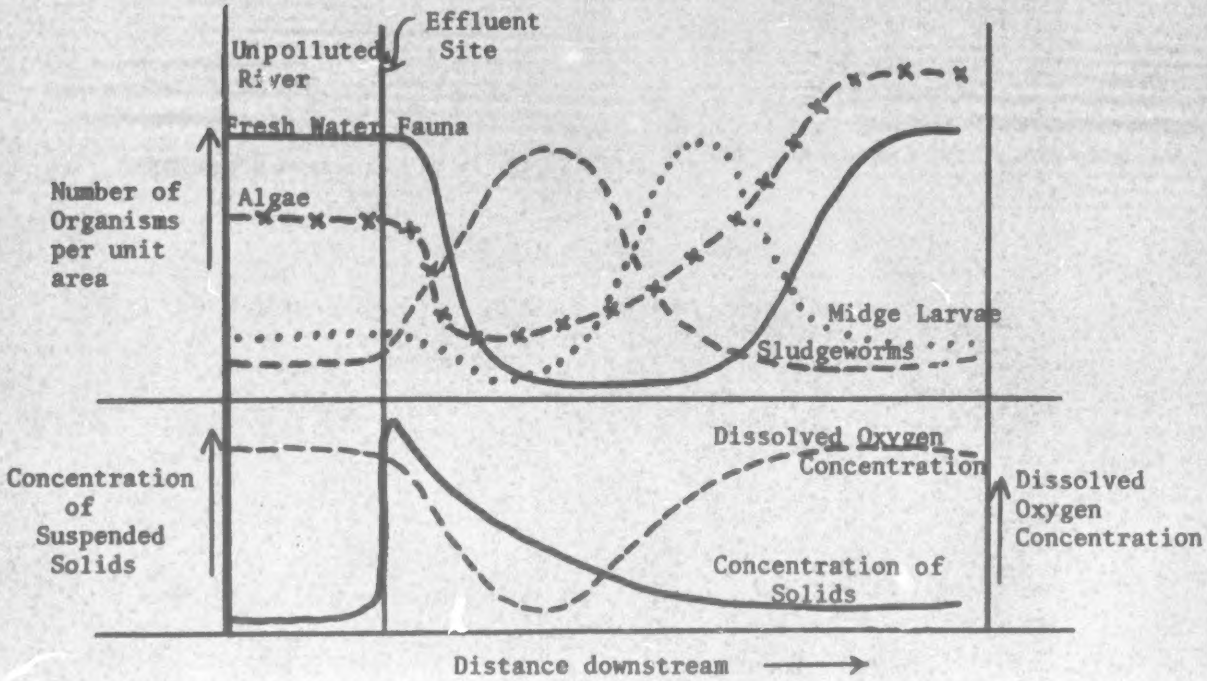
30212P
L.III - 65%
D1 - 78%

The pupal stage of the life cycle of the house flea lives in floor dust. Fleas tend to stay in this form until they respond to vibrations, whereupon they leap out of their cocoons to feed on blood. With no blood to feed on, the flea soon dies.

A real estate salesman hoping for a sale of a long-vacated house did not want his client to be bothered by fleas. The simplest solution for the salesman would be to

A. thoroughly clean the dust from the floor of the house.
B. have the house fumigated with insecticide.
C. run with heavy boots throughout the house a few days before bringing in the client.
D. search the house for fleas just before he brings in the client.

Study the information given below, taken from "Environmental Pollution", edited W.A. Andrews, 1972.



30222A
L.III - 36%
D1 - 52%

The organisms which perform best under moderate conditions of pollution, i.e. cloudy water and low oxygen, are

A. sludge worms.
B. midge larvae.
C. fresh water fauna.
D. algae.

30232L
L.III - NS
D1 - 79%

Low levels of pollution would be indicated best by high numbers and proportion of

A. sludge worms.
B. midge larvae.
C. freshwater fauna.
D. algae.

30242X
L.III - 21%
D1 - 42%

Thirty years ago, fish could be caught by anglers in the Rhine River, which flows through Western Europe. Today fish are non-existent in the Rhine, which has often been referred to as the "Sewer of Europe". Which of the following is the direct cause of this lack of fish in the Rhine?

A. lack of oxygen
B. raw sewerage pouring into the river
C. poisonous gases being given off due to chemical reactions taking place in the river

30252H
L.III - 70%
D1 - NS

If measurements were taken of the carbon dioxide concentration in a lake over a 24 hour period, when would it probably be lowest?

A. early in the morning
B. in the middle of the day
C. in the late afternoon
D. in the middle of the night

30262U
L.III - 53%
D1 - 64%

Since 1860 the percentage of carbon dioxide in the atmosphere has risen 10% (0.029% to 0.032%). Which of the following has not contributed to the increase?

A. Man has removed much of the earth's vegetation which uses carbon dioxide in photosynthesis.
B. The number of consumers has increased greatly during this time.
C. Much fossil fuel has been burnt during this time.
D. Man's use of previously unused parts of the earth's surface for food production has increased.

30272E
L.III - 14%
D1 - 33%

Crop pests can be controlled in several ways. The most effective, practical and least damaging to the environment is to

A. spray the crop with a pesticide like D.D.T.
B. introduce an animal which will prey on the pest.
C. introduce a predator of the pest that will not itself become a pest.
D. sterilize the pest insects in the community.

30282Q
L.III - NS
D1 - 60%

In which of the following situations is there least chance of seeing a succession of biological communities?

A. an area of eucalypt scrub burned in a bushfire
B. a small island following a volcanic eruption
C. a freshwater pond which has filled after a dry summer
D. a tropical forest community in equilibrium

30292B
L.III - 13%
D1 - 28%

If all green plants disappeared, which of the following substances normally found in the atmosphere would be depleted quickest?

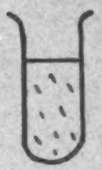
A. nitrogen
B. oxygen
C. carbon dioxide
D. water vapour

Many species of bacteria are mobile when supplied with adequate amounts of oxygen. When oxygen is withheld altogether or the supply is very low, the bacteria are stationary or move very slowly.

A student set up an experiment using 4 test tubes, a culture of actively moving bacteria, and sprigs of actively growing Myriophyllum (a green aquatic plant) as follows:

LIGHT

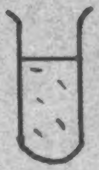
A.



5 ml deoxygenated water (boiled) and 1 ml bacteria culture

DARK

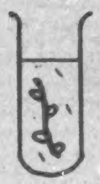
B.



5 ml deoxygenated water (boiled) and 1 ml bacteria culture

LIGHT

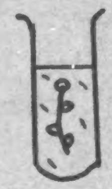
C.



5 ml deoxygenated water (boiled) and 1 ml bacteria culture and sprig of Myriophyllum

DARK

D.



5 ml deoxygenated water (boiled) and 1 ml bacteria culture and sprig of Myriophyllum

Tubes A and C were placed in sunlight.
Tubes B and D were placed in a darkened (lightproof) box.

30302M
L.III - 23%
D1 - 31%

If the student examined a sample of water from all 4 tubes after 6 hours, in which tube would he find the most active bacteria?

A number of semi-transparent "bloodless" fishes have been known to whalers working in the Antarctic Ocean since the late nineteenth century. A biologist on examining these fish found that they were not really bloodless.

The reason for their bloodless appearance (white muscle and white gills) was that their blood was transparent - contained no red blood cells and no respiratory pigment. Further investigation showed that oxygen was transported by the blood in solution in the water of the blood plasma.

30313Z
L.III - 54%
D1 - 64%

These fish would most likely carry out

A. anaerobic respiration.
B. aerobic respiration.
C. autotrophic nutrition.
D. saprophytic nutrition.

30323K
L.III - 41%
D1 - NS

One particular species of this group of fish grows up to 70 cm long, lives close to the bottom and feeds on small shrimps and fish. With this relatively active way of life, the adaptation most likely to be to the best advantage of the fish would be

A. a more efficient excretory system.
B. extra length to the digestive tract.
C. development of the skin as a secondary respiratory organ.
D. development of an enzyme to aid secondary breakdown of proteins.

30333W
L.III - NS
D1 - 72%

The reason why the fish can survive with this relatively primitive blood system is that

A. it lives in an environment in which the temperature ranges from -2°C to +2°C.
B. its excretory system compensates for the blood system.
C. it lives in an environment which has a rich food supply.
D. its more efficient respiratory system increases the ability of the blood system to carry oxygen.

Organs, Systems

40011Q
L.III - 71%
D1 - 75%

Which one of the following statements about blood circulation is not true?

A. Venous blood pressure is much lower than arterial blood pressure.
B. There is normally no direct connection between the right and left ventricles of mammalian hearts after birth.
C. Valves at intervals along the length of arteries help to prevent blood from flowing backwards.
D. When an animal dies, blood tends to pool in veins rather than in arteries, because veins are soft-walled and expand more.

40021B
L.III - 43%
D1 - 67%

At the onset of a virus infection it is very common for the lymph nodes beneath the ears to swell. An explanation for this swelling is an

A. accumulation of viruses in those areas.
B. accumulation of diseased cells in those areas.
C. increased production of red blood corpuscles.
D. increased production of white blood corpuscles.

40031M
L.III - 11%
D1 - 43%

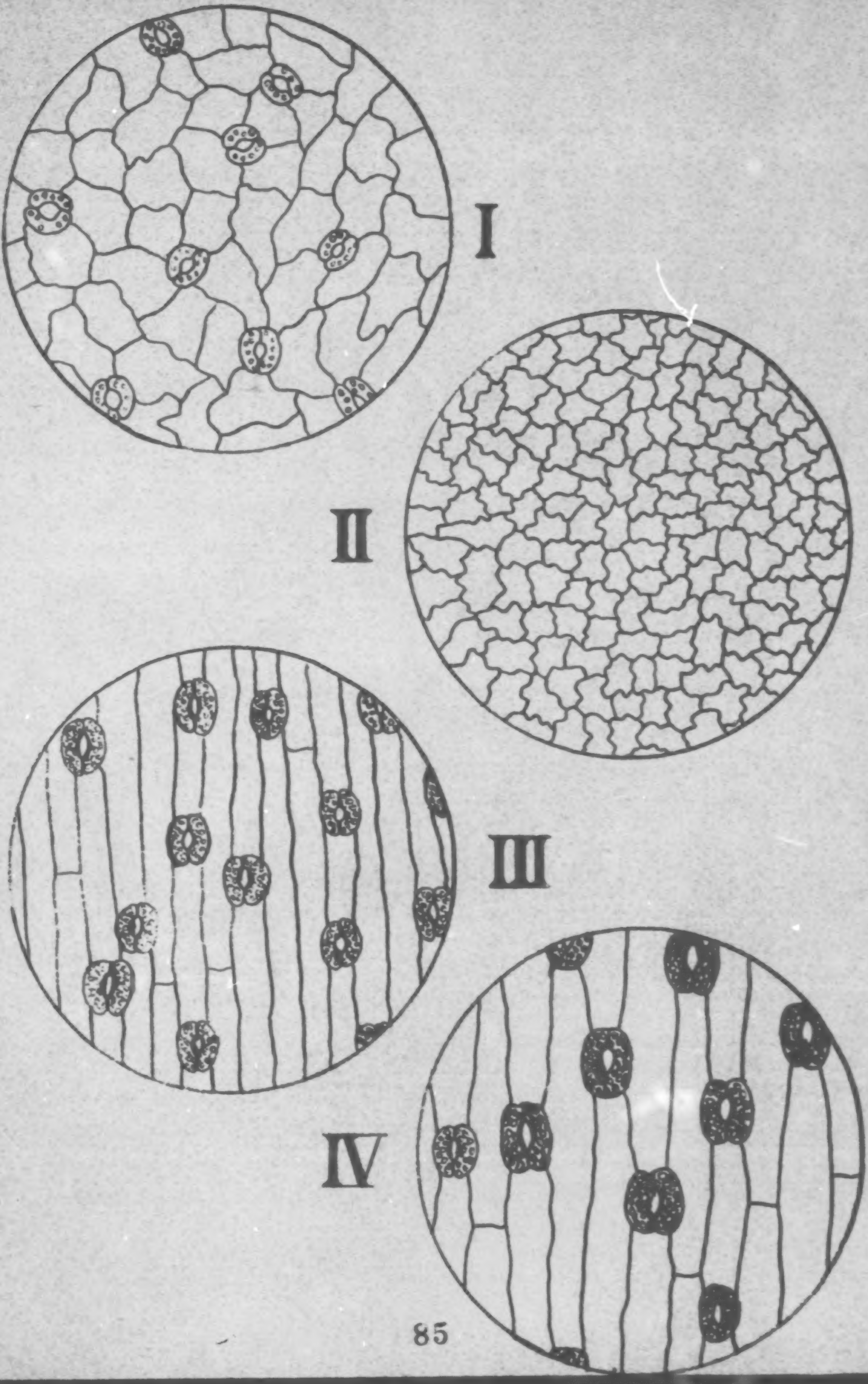
The stomach contains a strong acid and a proteolytic enzyme; the reason why the stomach wall is not digested is that

A. the enzyme is not active in the stomach.
B. the enzymes in the stomach are rapidly destroyed by the acid.
C. the cell membranes in the stomach do not contain protein.
D. the cells lining the stomach are covered by a protective material.

40041Y
L.III - 54%
D1 - 57%

All of the following are a necessary part of the explanation of the Cohesion-Tension theory, except one - which one is not?

A. the ability of the plant to take up water even when its roots are removed
B. the strong forces of attraction between water molecules
C. the negative pressure found in the xylem vessels
D. the presence of a continuous column of water found in the xylem vessels


I
II
III
IV

The four drawings are to the same scale and are respectively:

(I) Lower epidermis - leaf of plant A
(II) Upper epidermis - leaf of plant A
(III) Lower epidermis - leaf of plant B
(IV) Upper epidermis - leaf of plant B

The name stoma (plural - stomata) refers to a hole in the leaf surface and to both guard cells which surround it. Guard cells are specialised cells (often sausage shaped) containing chloroplasts as shown in the drawings. There are no chloroplasts in the other cells of the leaf surface.

Distribution of Stomata on Leaves

In dicotyledonous plants stomata normally occur in greatest numbers on the lower surface. Some species have comparatively few and some have none at all on the upper surface. Plants with leaves which stand in a nearly vertical position may have stomata about equally distributed on both surfaces. Many of the monocotyledons have leaves of this type.

In the majority of leaves, stomata are arranged without regular pattern or orientation. However, in most monocotyledons stomata are all orientated in the same direction. Many grasses show this directional orientation of stomata and, in addition, the stomata are arranged in regular rows forming a definite pattern.

40062W
L.III - 22%
D1 - 37%

From the above information a reason for supposing plant A to be a dicotyledon is that the

A. stomata are smaller than those of plant B.
B. leaves of plant A stand in a horizontal position.
C. stomata have no regular orientation.
D. stomata are about equally distributed on both surfaces.

40072G
L.III - 28%
D1 - 56%

Which of the following facts supports an hypothesis that plant B has leaves which stand in a nearly vertical position?

A. The stomata show regular orientation.
B. There are nearly as many stomata on the upper surface as there are on the lower surface of the leaf.
C. The epidermal cells are very long compared with their width.
D. The stomata are larger than those of plant A.
E. All of the above support the hypothesis.

40082T
L.III - 28%
D1 - 60%

Select from the following the statement which is NOT true.

A. In plant B the cells of the upper surface are, on the average, wider than those of the lower surface of the leaf.
B. In plant B the cells of the upper surface are, on the average, longer than those of the lower surface of the leaf.
C. The chloroplasts in the guard cells of both plants are approximately the same size.
D. The guard cells of plant A appear to contain approximately the same number of chloroplasts as those of plant B.
E. On the evidence of the data given plant B appears to be a monocotyledon.

40092D
L.III - 49%
D1 - 65%

The most likely function of the specialised guard cells would be to

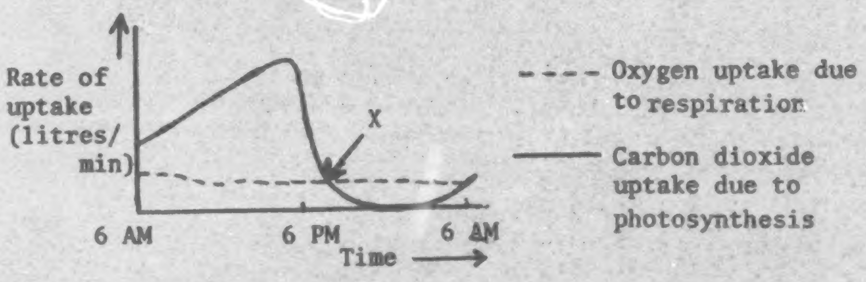
A. control the size of the holes in the leaf surface.
B. allow free exchange of gases between the leaf cells and the environment.
C. prevent water entering the inside of the leaf when it rains.
D. prevent the leaf from being attacked by insect predators.
E. prepare food on which the plant can live.

40052K
L.III - 40%
D1 - 52%

Learning is possible in all of the organisms below, except

A. Volvox.
B. grasshopper.
C. Hydra.
D. earthworms.

The graph below shows the rate of uptake of oxygen and carbon dioxide for respiration and photosynthesis respectively, over a 24-hour period.

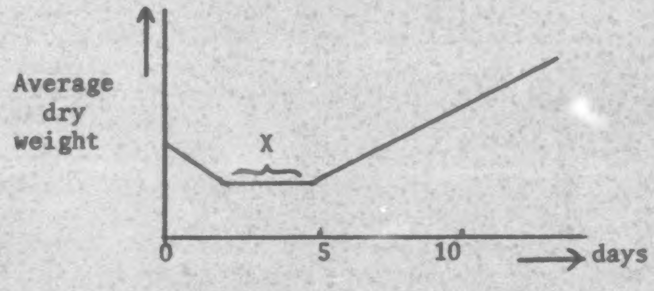


40102P
L.III - 16%
D1 - 27%

At point X on the graph

A. the respiration rate is greater than the photosynthetic rate.
B. the carbon dioxide uptake is greater than the oxygen uptake.
C. both respiration and photosynthesis are increasing.
D. oxygen uptake and carbon dioxide uptake are in equilibrium.

Some barley seeds were germinated. Samples were taken at regular intervals and their average dry weight calculated, as shown on the graph.



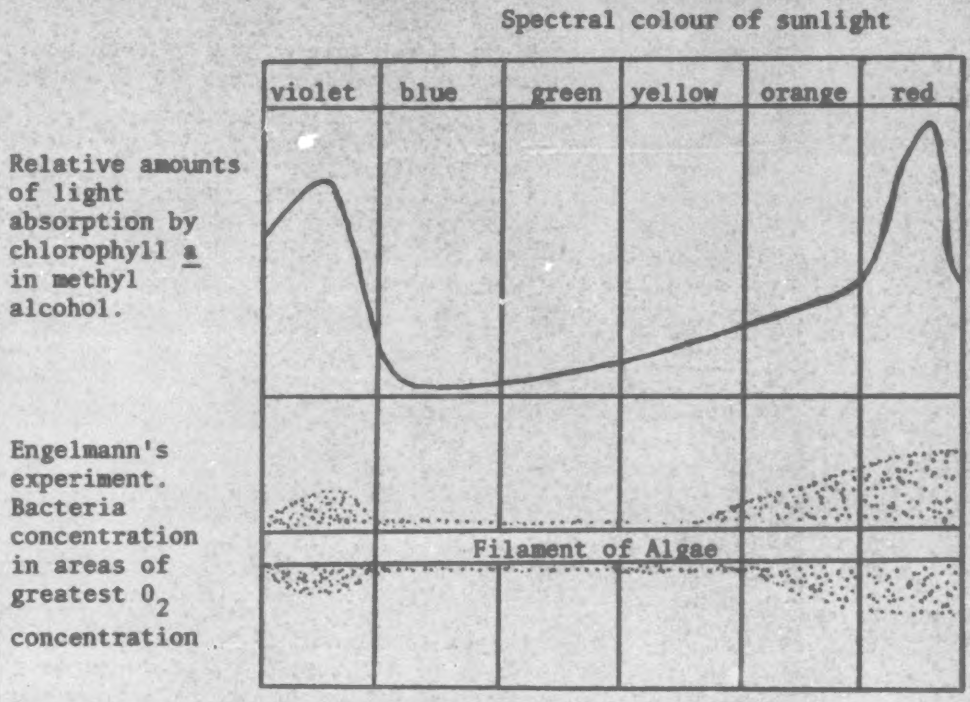
40112A
L.III - 43%
D1 - 46%

For section X on the graph one can assume that

A. photosynthesis has not yet started.
B. the seedlings are not growing.
C. weight gain from photosynthesis is equal to weight loss by respiration.
D. the weight loss is due to excessive loss of water by seeds as they germinate.

In 1882, T.W. Engelmann carried out the following experiment. He projected a whole spectrum on to a filament of a green alga in the presence of motile bacteria which tended to swim towards regions of high oxygen concentration. The experiment was carried out on a microscope stage and observed under high power.

In another experiment a spectrum was shone on to chlorophyll a in methyl alcohol. The results of these experiments are shown below:



40122L
L.III - 41%
D1 - 59%

The main purpose of Engelmann's experiment was to discover

A. which wavelengths of light are being used for photosynthesis.
B. which part of the filament of algae is responsible for photosynthesis.
C. which wavelength of light bacteria prefer to live under.
D. why chlorophyll a absorbs only some wavelengths of light.

40132X
L.III - 36%
D1 - 47%

The results of the two experiments showed that

A. these bacteria will congregate at the violet and red ends of the spectrum.
B. oxygen is being given off mainly at the violet and red ends of the spectrum.
C. chlorophyll a absorbs more violet and red wavelengths than any other wavelength of light.
D. all of the above are true.

40142H
L.III - 23%
D1 - 29%

The main conclusion which would be drawn from the above experiments is that

A. photosynthesis utilizes mainly violet and red light.
B. only parts of a filamentous alga are used for photosynthesis.
C. if a spectrum is shone on to bacteria they will move towards the red and violet parts.

40152U
L.III - 33%
D1 - 43%

Carbohydrates are stored as glycogen in the liver rather than as glucose. Which of the following properties of glycogen is not of benefit to the system?

A. Glycogen is easily converted to glucose for transport by the blood.
B. Glycogen is a large molecule which exerts an osmotic pressure on the cells of the liver.
C. Glycogen, being a larger molecule than glucose, has a higher potential energy.
D. Glycogen, being a molecule formed by condensation of glucose, takes up less room for storage.

40162E
L.III - 54%
D1 - NS

The Loop of Henlé forms part of the nephron, the excretory structures found in the kidney. Part of the job of the Loop of Henlé is to extract certain useful ions from the fluid passing through the loop. If the concentration of the solution of these ions inside the loop is less than that on the outside of the loop, by what process would ions pass out of the Loop of Henlé?

A. active transport
B. diffusion of solvent
C. osmosis
D. random movement of ions

40172Q
L.III - 56%
D1 - 64%

The nephron is surrounded by, and intertwined with, blood vessels which are connected to the renal artery on one side and the renal vein on the other. Of the following, which best describes the function of these blood vessels?

A. to supply oxygen to the cells of the kidney
B. to supply blood so all waste products can be removed
C. to allow supply of oxygen and allow some waste products to be removed from the blood
D. to allow the removal of all waste products and allow the reabsorption of oxygen into the blood

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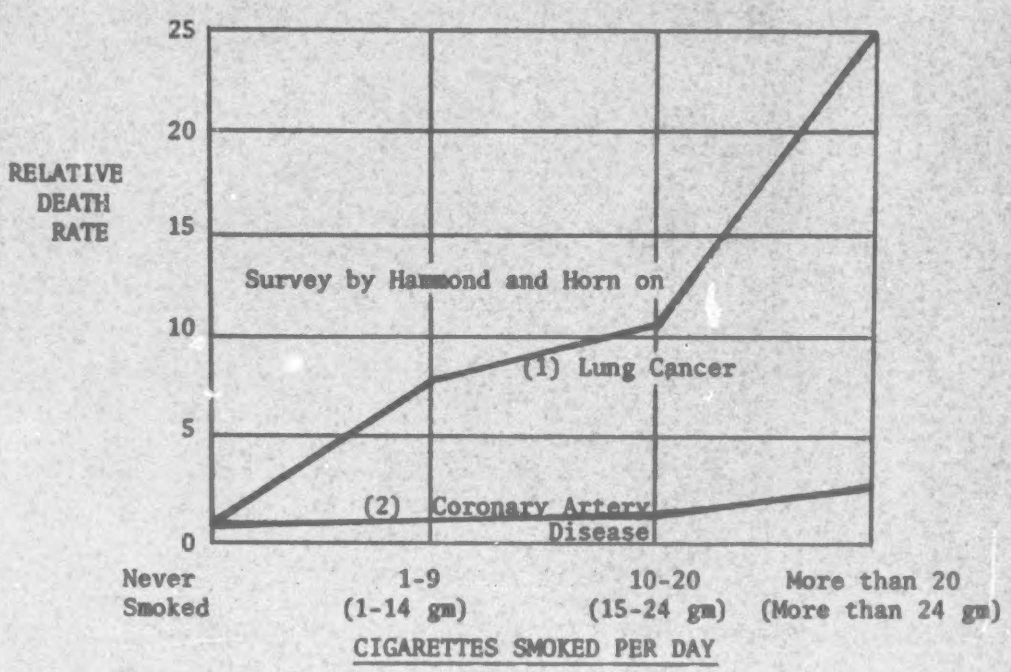
40182B
L.III - NS
D1 - 48%

During the evolution of the vertebrates, the heart, like other organs, underwent several changes. Fish have a two-chambered heart whereas mammals have a much more efficient one with four chambers. The most likely selection pressure to produce this change would be adaptation to

A. life on land.
B. homoiothermy.
C. a more complex form of reproduction involving viviparity rather than egglaying.

The questions below are based on the following information (Ref. Sc. Am., July 1962, Vol. 207, No. 1), from research into the effects of smoking.



"Relative death rate" is death rate among smokers divided by death rate among non-smokers.

40192M
L.III - 40%
D1 - 51%

Of the following, which is the best conclusion from the graph?

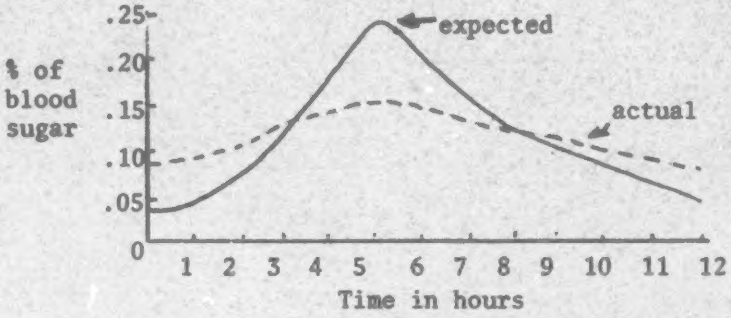
A. A person who consumes 10-20 cigarettes a day is 11 times more likely to die from lung cancer than a person who does not smoke cigarettes.
B. If 50 people died from lung cancer you would expect 40 of them to have smoked between 10 and 20 cigarettes a day.
C. People who smoke more than 10 cigarettes a day have twice the chance of dying from lung cancer compared with people who do not smoke.
D. People who smoke more than one cigarette a day are 10 times more likely to develop lung cancer than those who do not smoke.

40202Y
L.III - 52%
D1 - NS

Of the following, which is the best conclusion from the graph?

A. A person who smokes 10-20 cigarettes a day is less likely to die from coronary artery disease than one who smokes from 1-9 cigarettes a day.
B. If 100 people die from coronary artery disease we would expect 90 of them to have smoked more than 20 cigarettes a day.
C. A person who smokes more than 20 cigarettes a day is 2½ times more likely to die from coronary artery disease than a person who does not smoke.
D. A person who smokes 40 cigarettes a day is twice as likely to die from coronary artery disease as a person who does not smoke.

A student was asked to participate in the following experiment. He fasted for 12 hours and then had a meal of sugary milk. This was followed by a further fasting period of 12 hours. During this latter period of time his blood sugar concentration was measured at hourly intervals. The graph below represents what was expected and the actual amounts obtained.



40212J
L.III - 43%
D1 - 71%

Assuming there was no mistake in measurements, the difference between the expected curve and that actually obtained is best explained by one of the following. Which one is it?

A. There was a removal of sugar from the blood and a storage in the body.
B. There was too much sugar and the excess was excreted.
C. The body used more sugar than was expected.
D. The body did not digest and absorb all the sugar.

40222V
L.III - 34%
D1 - NS

The mechanism of the movement of the contents of the sieve tubes in plants cannot be defined as diffusion since

A. the phloem contains a 10% solution of sucrose.
B. the rate of flow is many times faster than the rate of diffusion.
C. the mature sieve tube cells do not contain a nucleus.

For each of the following conditions, choose whether the guard cells of a leaf would probably be

A. fully open.
B. partially open.
C. completely closed.

40232K
L.III - 29%
D1 - NS

atmosphere very moist, a large amount of water in the soil, sunlight plentiful

40242R
L.III - 45%
D1 - NS

atmosphere moist, plentiful supply of soil water, cloudy

The questions below depend upon the following information:

> A green waterplant was sealed in a tube of pondwater coloured with phenol-red. At the end of the day the red colour had not changed, but the next morning the medium was yellow, showing it was then acidic. No change of colour was observed in a similar set-up containing no plant.

40252C
L.III - 12%
D1 - 26%

These results indicate that

A. light causes a change in the colour of phenol-red.
B. darkness causes a change in the colour of phenol-red.
C. an acidic substance is produced by a green plant in the light.
D. an acidic substance is produced by a green plant in the dark.

40262N
L.III - 35%
D1 - 65%

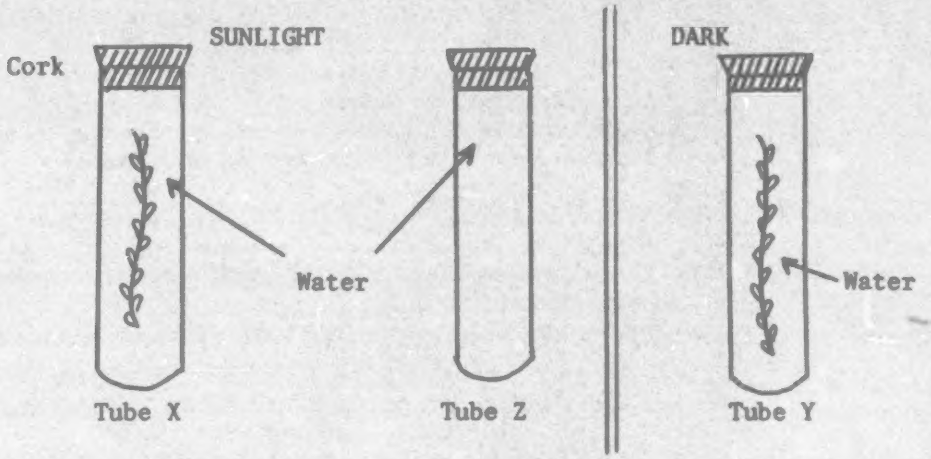
The experiment was probably testing whether

A. green plants respire.
B. phenol-red is an indicator.
C. light is necessary for photosynthesis.
D. phenol-red is yellow in acid.

40272Z
L.III - 32%
D1 - 34%

If a few drops of concentrated manganese sulphate solution and a few drops of sodium hydroxide solution are added to a solution containing oxygen, a brown precipitate will result. The greater the oxygen content of the test solution, the deeper the brown colour that is produced.

Three tubes marked X, Y and Z respectively were filled with water. An actively growing sprig of Elodea (a green aquatic plant) was placed in tubes X and Y. Tubes X and Z were placed in sunlight, tube Y in the dark.



After 3 hours the Elodea was removed, and a few drops each of manganese sulphate and sodium hydroxide were added to each tube.

The precipitate of darkest colour was most likely found in

A. tubes X and Y equally.
B. tube X.
C. tube Y.
D. tube Z.

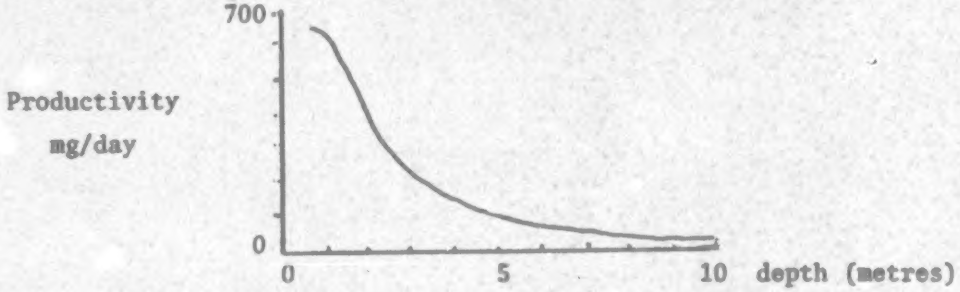
Cellulose-digesting microorganisms are found in the alimentary canals of cows and horses. In cows they live in the rumen (a chamber of the "stomach") but in horses they live in the caecum (an extension of the large intestine). The products of cellulose digestion are fatty acids which pass on through the alimentary canal.

40282K
L.III - 61%
D1 - NS

The cow can get more nutrition from the relationship because, in the cow's system,

A. fatty acids have a greater chance of being absorbed.
B. fatty acids can be broken down more easily in the "stomach".
C. cellulose would be broken down by the time it reached the caecum and therefore would be less suitable for micro-organisms.
D. fatty acids are less likely to influence absorption in the large intestine.

Measurements were made of the rate of growth of phytoplankton at different depths in a freshwater lake:



40292W
L.III - NS
D1 - 17%

The decrease in productivity with depth would most likely be related to

A. the decreased solubility of oxygen and carbon dioxide with increase in pressure.
B. the decrease in the amount of light available for photosynthesis.
C. an increase in pressure causing damage to plant cells.
D. an increase in the number of consumers.

40302G
L.III - 29%
D1 - 28%

At one time men thought that all the matter in a plant came from the water supplied to the plant. If this were true, which of the following would equal the gain in weight of a growing plant?

A. the weight of water poured on the plant
B. the difference between the weight of water entering the plant and water leaving the plant
C. the difference between the weight of atmospheric gases entering the plant and atmospheric gases leaving the plant
D. the sum of the weight of water and atmospheric gases entering the plant

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40312T
L.III - 58%
D1 - NS

Plants living in dry regions have a relatively slow rate of growth compared with plants in other regions. The probable reason for this is

A. the presence of a thick cuticle on the leaves which slows down diffusion of gases into the leaf.
B. poor root development which slows down the uptake of minerals from the soil.
C. the slow rate of respiration due to lack of water.
D. the closure of the stomata to prevent loss of water.

40322D
L.III - 46%
D1 - 60%

For several centuries man believed that a plant grew because its roots were consuming soil. Which of the following procedures would be most useful in testing the truth of this idea?

A. Find if the same chemicals are present in plants and soil.
B. See if the weight of soil in a pail decreases as a plant grows in the pail.
C. Note the weight of plants grown in several different types of soil.
D. Find out what effect the addition of water has on the growth rate of several different plants.
E. Make comparisons between the rate of growth of plants and the density of the soil the plants are growing in.

40332P
L.III - 15%
D1 - 28%

Of the following, the animal whose chemical reactions would be most affected by a 10°C fall in external temperature would be a

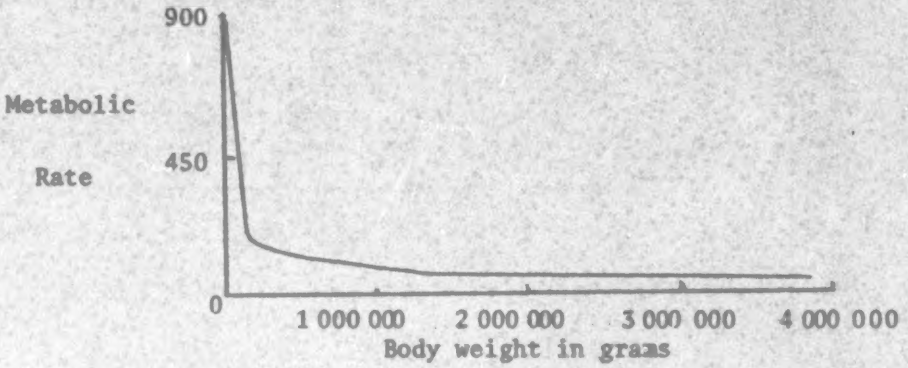
A. man.
B. dog.
C. snake.
D. budgerigar.

40342A
L.III - NS
D1 - 69%

Many warm blooded animals will become dormant or hibernate when the environmental temperature is low or the food scarce. A consequence of this is that, usually,

A. food reserves will be used up and the animal will die.
B. the animals will soon become dehydrated as they can no longer take in water.
C. their body temperature will fall below the normal set point.
D. their body temperature will remain at the normal set point as they are homoiothermic.

The graph below represents the relationship of metabolic rate and body size in mammals. (Metabolic rate is given in cubic millimetres of O_2 per gram of body weight per hour.)



40352L
L.III - 31%
D1 - NS

From the above graph it can be predicted that

A. elephants should have a high metabolic rate.
B. mice should have a low metabolic rate.
C. mammals weighing less than 100 000 grams should be extremely active.
D. mammals with a large surface area-to-volume ratio should have a low metabolic rate.

40363Y
L.III - NS
D1 - 48%

It has been found experimentally that mice and dogs can breathe water instead of air provided certain conditions are met. Which combination of two of the following conditions should prove to be most practical to achieve the above result?

I Put the lungs on the outside of the body.
II Greatly increase the amount of oxygen in the water.
III Have the water at the same osmotic pressure as the blood.
IV Change the shape of the lungs so that they are like gills.

A. I and IV
B. II and IV
C. II and III
D. III and IV

40373J
L.III - 37%
D1 - 45%

Experiments with pregnant rats show that the foetus can survive decelerations of up to 10 000 g (g = force of gravity), although the mother rats themselves die. A deep sea diver risks death, if he surfaces too quickly, due to release of gas bubbles in his blood. The sudden decompressions experienced by the diver are akin to the decelerations experienced by the foetus.

The experiments with rats suggest that the diver could survive sudden decompression provided he

A. could breathe oxygen from a liquid.
B. was surrounded by soft materials.
C. held his breath during the decompression period.
D. was very young.

Interaction, Maintenance

50011K
L.III - 64%
D1 - 72%

Homeostasis is the biological phenomenon involved in all but one of the following. Which one does not involve this?

A. the maintenance of body temperature in poikilothermic animals
B. feedback mechanisms
C. sugar concentration in blood plasma
D. composition of urine in mammals

50021W
L.III - 33%
D1 - 32%

Which of the following is not recycled, in a biological sense?

A. organic matters
B. carbon dioxide
C. oxygen
D. energy

50032H
L.III - 36%
D1 - 62%

The presence of sugar in the urine of a diabetic does not necessarily indicate that the kidneys are functioning improperly. It generally means that the blood-sugar concentration is higher than normal and that the kidneys are removing part of the excess. The liver plays a critical role in regulating blood-sugar levels. The muscles are also important elements in this regulatory system.

Which of the following would not be caused by insulin acting to reduce the concentration of glucose in the blood?

A. stimulation of the muscles to remove more glucose from the blood
B. stimulation of both the muscles and the liver to convert more glucose into glycogen for storage
C. stimulation of the liver to produce glucose from glycogen or other stored materials
D. stimulation of the muscles and the liver to oxidize carbohydrates at a more rapid rate

50042U
L.III - 59%
D1 - NS

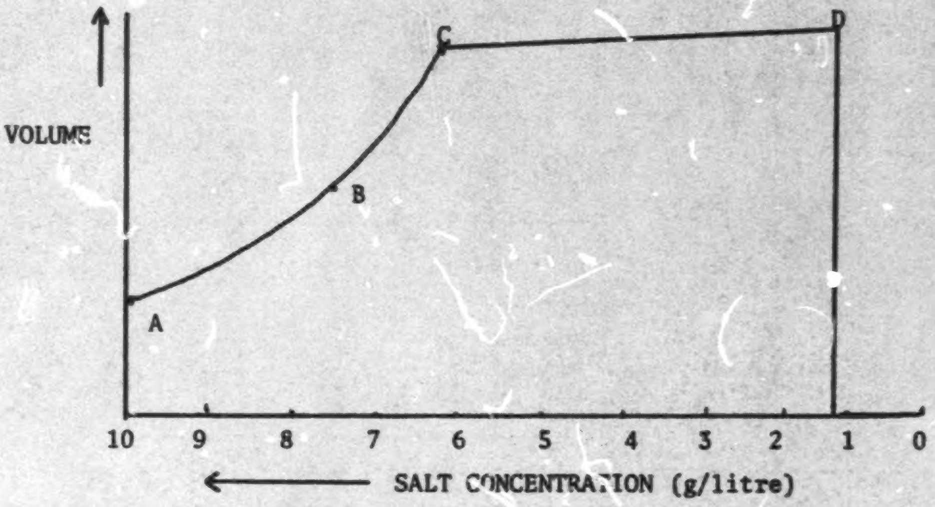
Oestrogen and progesterone are two hormones which are produced by the ovary. One of their important functions is to ensure preparation of the uterus for receiving the fertilized ovum. In an experiment on mature female rats the pituitary was removed and it was found that the rats ceased to produce young.

Which of the following inferences can be drawn from the results of this experiment?

A. The pituitary influences the ovaries.
B. The pituitary is necessary for reproduction.
C. The pituitary influences both the ovaries and the uterus.
D. There is a complex interaction between the pituitary and the reproductive organs.

The following questions relate to the paragraph and graph below:

> A scientist had some plant material and he wished to find the approximate salt concentration in the cells of this plant. To do this he placed some material in solutions of different salt concentration and measured the volume of one cell (measurements of volume enclosed by membrane). The following results were obtained:



50052E
L.III - 37%
D1 - 46%

Which point corresponds to the approximate salt concentration of the cell?

50162Z
L.III - 57%
D1 - NS

The best explanation for what has occurred at D is that the

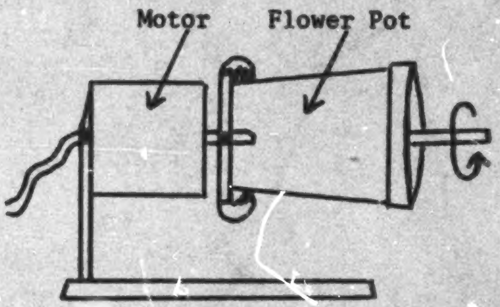
A. cell has died.
B. membrane has become permeable to salt.
C. membrane has become permeable to water.
D. cell has burst.

50154Q
L.III - 69%
D1 - NS

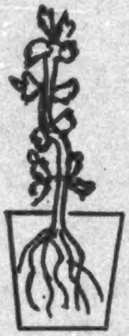
Change seems to be an almost universal characteristic of natural communities. Such communities tend towards a climax governed by a particular climate. This climatic climax is usually not reached because of soil factors or, more generally in Tasmania, fire. Eucalypt forests regenerate when fire clears the vegetation and seed falls from adult trees. Button grass plains are thought to be the result of frequent firing of eucalypt forest by the Tasmanian Aborigine.

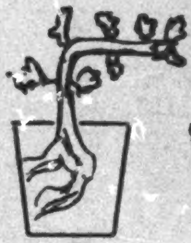
Which of the following statements is most relevant to Tasmania?

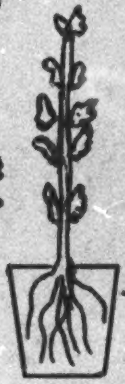
A. The climatic climax community is eucalypt forest.
B. If eucalypt forests are burnt down their replacement is button grass plains.
C. Soil type is more important than climate in determining vegetation.
D. Eucalypt forests can be eliminated by frequent fires.

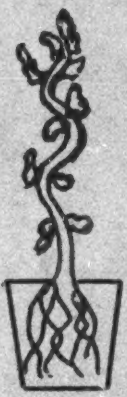


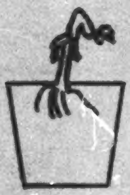
The apparatus shown is called a klinostat. The motor causes the flower-pot to rotate about the horizontal axis at a speed which can be selected by the user. Balsam plants, which were already well established in identical pots, were placed in some of these apparatuses for 30 days. When the plants were removed the following results had been obtained. (DIAGRAMMATIC SECTIONS SHOWN)


A.


B.


C.


D.


E.

50063R
L.III - 32%
D1 - 38%

Shortly after the experiment commenced the motor of one klinostat fused and could not be repaired. The plant remained in the apparatus for the entire experiment. Which of the above plants was it most likely to be?

50073C
L.III - 18%
D1 - 15%

One weekend the cleaner inadvertently switched off one klinostat. The klinostat was switched on again after 2 days and the plant kept in the apparatus for the entire experiment. Which of the above plants was it most likely to be?

50083N
L.III - 34%
D1 - 47%

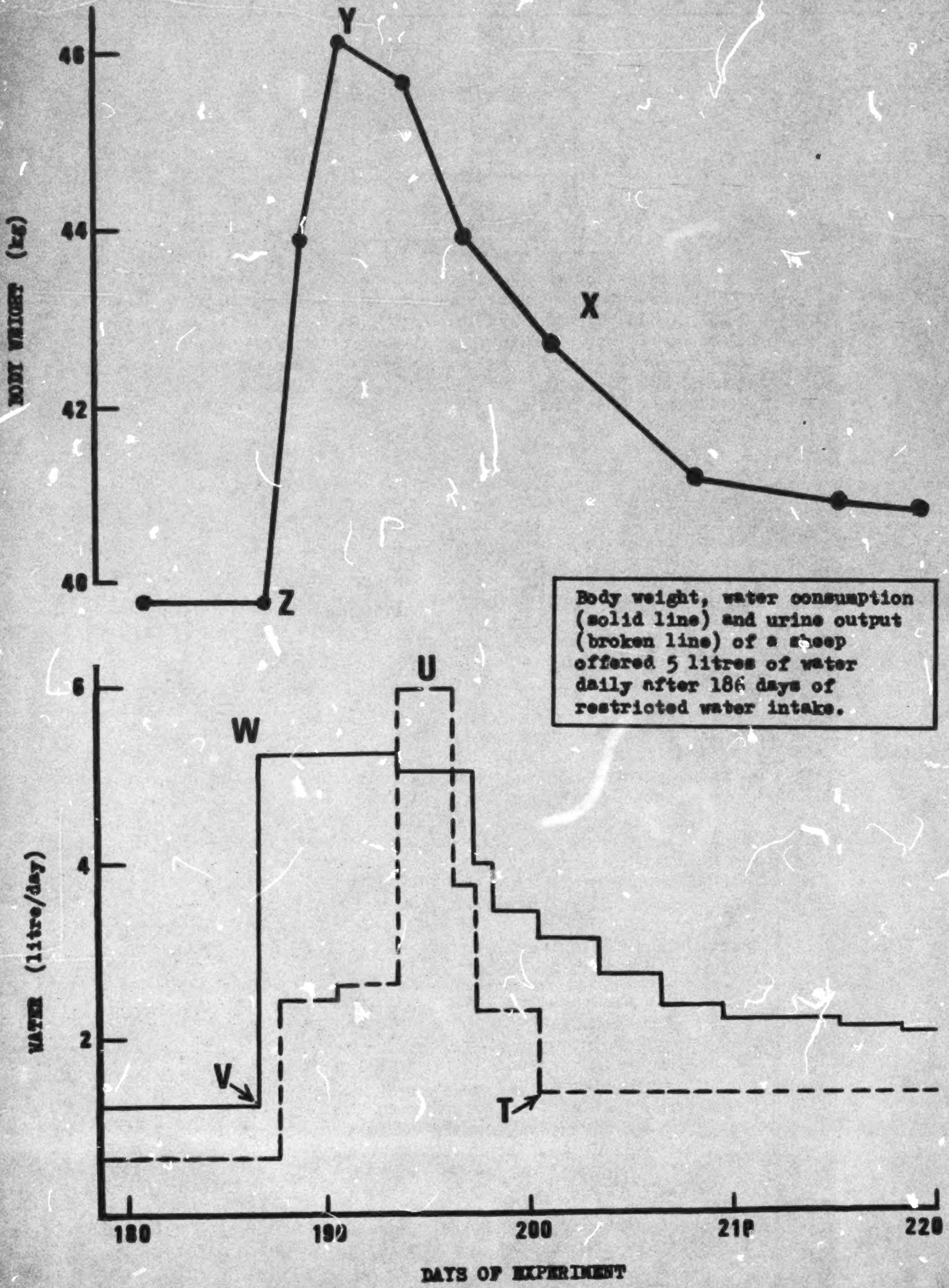
Which of the following explanations would be most likely to account for the result shown in diagram E?

A. The plant became infected with a virus disease.
B. The klinostat was set to revolve at only one revolution per day.
C. The klinostat was set to revolve at only one revolution per week.
D. The pot was less porous than the others and thus received too little water.
E. The plant was larger than the others at the start and became pot-bound.

50093Z
L.III - 48%
D1 - 54%

From the explanations in the previous question, which one would be most likely to account for the result shown in diagram D?

Study the graphs below and then answer the questions on the next page.



Body weight, water consumption (solid line) and urine output (broken line) of a sheep offered 5 litres of water daily after 186 days of restricted water intake.

50103K
L.III - 38%
D1 - 33%

One klinostat was set to revolve at 4 revolutions per minute when the recommended speed is 2-4 revolutions per hour. Of the above plants which one most probably came from this apparatus?

50114X
L.III - 36%
D1 - 52%

The increase in body weight from Z to Y on the graphs opposite can be directly associated with

A. increase in the amount of food consumed.
B. decrease in the production of dilute urine.
C. decrease in metabolism because the sheep do not have to search for water.
D. increase in water consumption.

50124J
L.III - 31%
D1 - 52%

From the graphs it can be seen that, during the time the sheep had a restricted water intake, they were allowed to drink

A. no water at all.
B. about 80 ml of water daily.
C. about one litre of water a day.
D. about five litres of water a day.

50134U
L.III - 65%
D1 - 60%

From the graphs and from a knowledge of biology it can be seen that during the period of restricted water intake the production of urine was about

A. the same as the amount of water drunk.
B. the same as the amount of water lost from the lungs, skin and bowel.
C. half the increase in body weight each day.
D. twice the amount of water retained by the body.

GENERALISATION:

> When many species of mammal are dehydrated by being totally deprived of water for several days and are then given unlimited access to water, rehydration is prompt and usually complete, with over-compensation rare and insignificant so that it is uncommon for water to be ingested in excess sufficient to give rise to water diuresis.

The purpose of the experiment was to test the validity of this generalisation. After obtaining the results shown on the graph the scientist (Warner, 1971) concluded that

> "... when sheep are subjected to a chronic dehydration by prolonged reduction in water intake, and then given access to ample water, readjustment occupies several weeks and includes periods of gross over-compensation and a marked water diuresis."

50144E
L.III - NS
D1 - 59%

The part of the graphs that directly demonstrates the occurrence of "marked water diuresis" is

A. vertical distance UT.
B. peak W.
C. horizontal distance UV.
D. curve X.

Cellular Level

60011E
L.III - 27%
D1 - NS

Each protein is made up of many amino acids. Different proteins differ in

A. the total number of amino acids.
B. the proportions of different amino acids.
C. the order in which amino acids are arranged.
D. all of the above features.

60021Q
L.III - 43%
D1 - NS

Aerobic respiration releases more energy for use by an organism than anaerobic respiration because

A. oxygen is a requirement for aerobic respiration but not for anaerobic respiration.
B. aerobic respiration results in a more complete breakdown of sucrose than anaerobic respiration.
C. the process of aerobic respiration requires more energy for its completion.
D. a by-product of aerobic respiration is carbon dioxide while that of anaerobic respiration is alcohol.

60031B
L.III - 51%
D1 - 71%

At least some cells of all plants do not contain

A. a nucleus.
B. mitochondria.
C. ribosomes.
D. chloroplasts.

60041M
L.III - 24%
D1 - 46%

The burning of wood is a process involving the release of energy by oxidation. A comparable process in the cell is

A. photosynthesis.
B. excretion.
C. digestion.
D. respiration.

60051Y
L.III - 14%
D1 - 28%

Which element is not found in carbohydrates but is found in proteins?

A. carbon
B. nitrogen
C. hydrogen
D. oxygen

A type of toadstool, *Mycena* sp., which grows in Japan has been found to be luminous.

60061J
L.III - 33%
D1 - 29%

The total amount of energy emitted as light from the toadstools would be

A. less than the total amount taken in from the environment.
B. equal to the total amount taken in from the environment.
C. more than the total amount taken in from the environment.

60071V
L.III - NS
D1 - 75%

The nutrition of these toadstools would certainly be described as

A. photosynthetic.
B. autotrophic.
C. heterotrophic.
D. saprophytic.

60081F
L.III - 68%
D1 - 88%

Of the following statements about enzymes, one is *not* always correct. Which is it?

A. They break down large molecules into smaller ones.
B. The substance upon which they work is called the substrate.
C. They are catalysts.
D. The name is derived from the Greek word, zymos, meaning yeast.

60091R
L.III - 50%
D1 - 60%

Which one of the following statements on the two kinds of nucleic acids is *incorrect*?

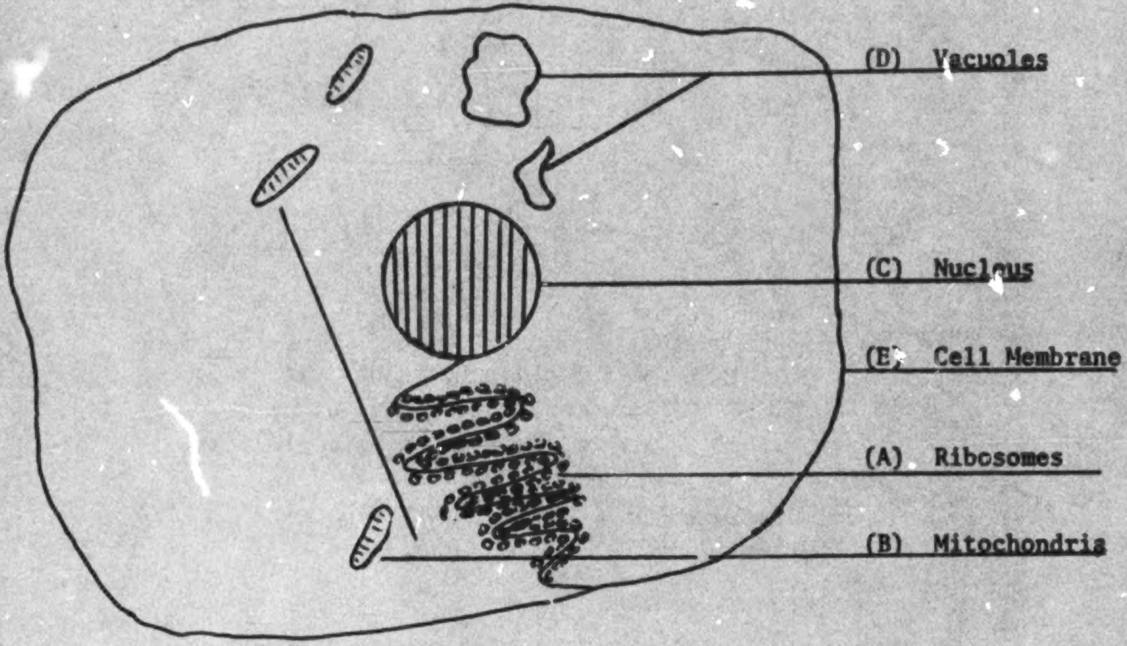
A. They are composed of base plus sugar plus phosphate molecules.
B. They are found in the nucleus.
C. They can both pass through the nuclear membrane.
D. They differ from one another in the bases they contain.

60222J
L.III - 44%
D1 - 43%

Excessive amounts of fertiliser added to soil, without adequate knowledge of the nutrient content of the soil, can produce poor plant growth. Of the following the best reason for this is that

A. plant roots dehydrate by osmosis.
B. too much of one ion can restrict the uptake of another.
C. too many ions may decrease the action of decomposer organisms.
D. too many ions reduce the supply of oxygen which is essential for plant root growth.

The following questions relate to the diagram below:



60102D
L.III - 52%
D1 - 75%

In which area does active protein synthesis occur?

60112P
L.III - 51%
D1 - 61%

In which area are there enzymes which are capable of breaking down glucose?

60122A
L.III - NS
D1 - 42%

If this was a unicellular fresh water organism, which structures would be very active in maintaining water concentration?

60132L
L.III - 48%
D1 - 58%

In which organelle does the process $\mathrm{ADP} + \mathrm{P} \xrightarrow[\text{enzyme}]{\text{"x"}} \mathrm{ATP}$ occur?

60142X
L.III - 38%
D1 - NS

"x" in the above equation is most likely to be

A. energy.
B. protein.
C. sugar.
D. water.

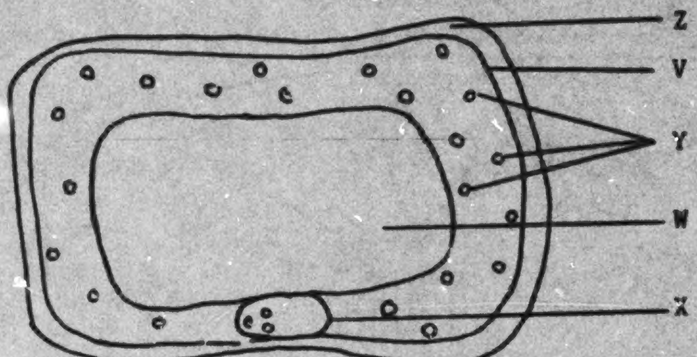
60152H
L.III - 67%
D1 - 70%

The equation $\mathrm{ADP} + \mathrm{P} \xrightarrow[\text{enzyme}]{\text{"x"}} \mathrm{ATP}$ describes what happens when

A. carbohydrate is metabolised.
B. starch is synthesised.
C. protein is formed.
D. diffusion occurs.

60162U
L.III - 19%
D1 - 36%

In which organelle is DNA found?



The diagram above represents a cell from an unknown piece of tissue. Answer the following questions with reference to the above information.

60172E
L.III - NS
D1 - 11%

If organelles 'Y' are coloured green they are most probably

A. oil droplets.
B. vacuoles
C. nuclei.
D. chloroplasts.

60182Q
L.III - 86%
D1 - NS

If organelles 'Y' were absent or colourless, then the cell could be identified as

A. plant.
B. animal.
C. plant or animal.

60192B
L.III - 48%
D1 - 81%

If organelles W and Z were absent, the cell would most probably be

A. dead.
B. of animal origin.
C. of plant origin.
D. lacking in essential mineral ions.

60202M
L.III - 57%
D1 - NS

If organelle 'V' was absent, the cell would most probably be

A. dead.
B. of animal origin.
C. of plant origin.
D. lacking in essential mineral ions.

60212Y
L.III - 78%
D1 - NS

What is the best explanation of how 'W' is formed?

A. The organelle increases in size to allow the cell to control all of its biochemical activities efficiently.
B. The organelle takes a major role in metabolism in exchange of gases and fluids.
C. The cell cannot cope with metabolism as it grows unless 'W' is present.
D. The cell increases in size but the amount of cytoplasm remains virtually unchanged.

The following information relates to the questions below:

> Assume that 75 g of a sugar Abiose undergoes partial hydrolysis to produce 50 g of Xiose and 25 g of Diose or 50 g of Yiose and 25 g of Fiose, all of which are more simple sugars than Abiose. The Xiose will undergo further hydrolysis to produce 25 g each of the sugars Ciose and Fiose, which in turn will not undergo further hydrolysis. Diose does not hydrolyse.

60232V
L.III - NS
D1 - 57%

Abiose is a

A. monosaccharide.
B. disaccharide.
C. trisaccharide.
D. polysaccharide.

60242F
L.III - 67%
D1 - 74%

Yiose is composed of

A. Fiose and Ciose.
B. Ciose and Diose.
C. Xiose and Fiose.
D. Diose and Fiose.

60252R
L.III - 32%
D1 - 45%

Fiose is a

A. monosaccharide.
B. disaccharide.
C. trisaccharide.
D. polysaccharide.

60262C
L.III - 55%
D1 - 55%

If Fiose and Diose were dehydrated under the right chemical conditions they would form

A. Xiose.
B. Yiose.
C. Abiose.
D. some other sugar.

60272N
L.III - 55%
D1 - 55%

A greater number of enzymes are involved in the completion of aerobic respiration than in anaerobic respiration because

A. aerobic respiration involves a greater number of chemical reactions.
B. aerobic respiration produces more energy.
C. anaerobic respiration involves a greater number of chemical reactions.
D. aerobic respiration is carried out by more complex organisms.

The questions below are based on the following information:

A biologist investigating a pure culture of microorganisms found that they hydrolyse maltose to glucose which they then use as a source of energy. The microorganisms can survive in a medium in which maltose is the only source of carbon. A substance S which specifically prevents the enzyme maltase from acting is added to the culture.

60282Z
L.III - 23%
D1 - 37%

After the introduction of substance S the biologist would expect the microorganisms to

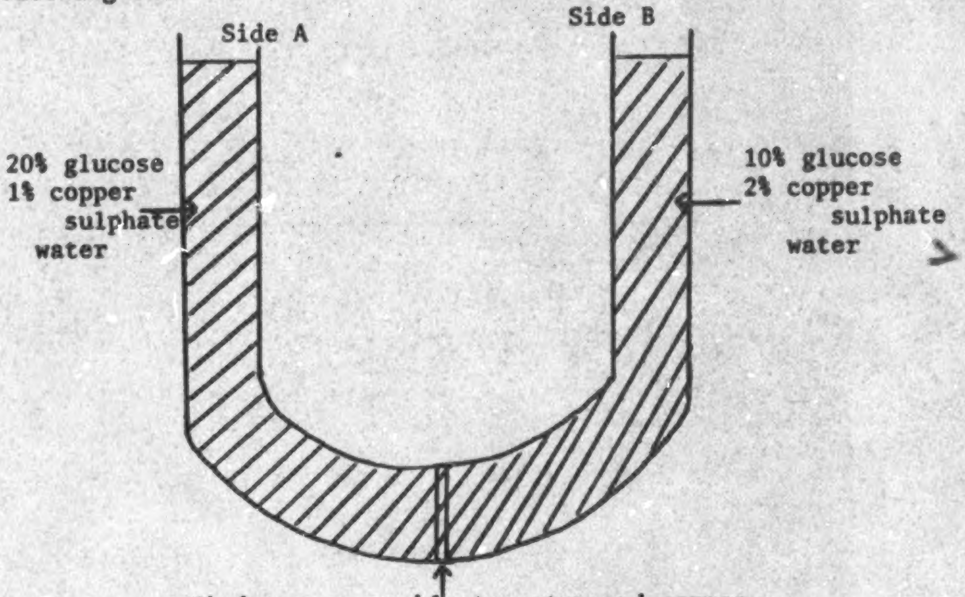
A. rapidly decline in number.
B. reproduce more rapidly.
C. reproduce but more slowly than before.
D. live but lose the power to reproduce.

60292K
L.III - 40%
D1 - 52%

Which of the following would have to be introduced if the biological processes of the microorganisms were to continue as they were before substance S was introduced?

A. maltose
B. maltase
C. sucrose
D. glucose

For the questions below, refer to this diagram and to the following data:



Membrane permeable to water and copper sulphate but impermeable to glucose.

At the beginning of the experiment, the solutions in the two arms of the tube are as pictured. They are separated at the bottom of the tube by a differentially permeable membrane. The volumes on either side of the tube are the same, and thus the level of liquid in both arms is also the same. The apparatus is allowed to stand for several days.

60302W
L.III - 51%
D1 - 68%

The glucose solution of side A will

A. become more concentrated and that on side B will become less concentrated, since water moves from A to B.
B. become more concentrated and that on side B will become less concentrated since water passes from B to A.
C. become less concentrated and that on side B will become more concentrated since water passes from A to B.
D. become less concentrated and that on side B will become more concentrated since water passes from B to A.

60312G
L.III - 33%
D1 - 41%

Of the following, which one best describes what will happen to the copper sulphate as the experiment proceeds?

A. There will be no passage of copper sulphate because solutes do not go through semi-permeable membranes.
B. There will be a slight passage of this substance but the passage will be restricted by the size of the pores in the membrane.
C. There will be a slow movement, since the concentrations are nearly equal.
D. There will be no passage as the copper sulphate is insoluble.

60322T
L.III - 61%
D1 - 68%

Osmotic pressure will be greatest on

A. side B at the beginning of the experiment.
B. side B at the end of the experiment.
C. side A at the beginning of the experiment.
D. side A at the end of the experiment.

Continuity

70011Z
L.III - 41%
D1 - 61%

A mutation is best defined as

A. the sudden appearance of a new character that is subsequently inherited.
B. the modification of a structure by use or disuse.
C. a small change in an organism induced by a sudden environmental change.
D. a change that is not seen in succeeding generations.

70021K
L.III - 41%
D1 - 74%

New gene combinations are found after meiosis as a direct result of

A. spindle formation.
B. pairing of homologous chromosomes.
C. separation of homologous chromosomes.
D. separation of chromatids.
E. crossing over between chromatids.

70031W
L.III - 41%
D1 - NS

Which of the following is always true of a species that reproduces sexually?

A. Some individuals of the species are male and others female.
B. Copulation always takes place between two individuals.
C. The species must have evolved recently in evolutionary history.
D. Meiosis takes place at some stage in its life.

70041G
L.III - 30%
D1 - 59%

The offspring of sexually reproducing organisms show greater diversity than the offspring of organisms that reproduce asexually. The chief reason for this is that

A. sexually reproducing organisms have a higher mutation rate.
B. sexually reproducing organisms have greater powers of dispersal, so their offspring encounter more varied environments.
C. genes are reshuffled during meiosis and fertilization.
D. asexually reproducing organisms show less structural variation than sexually reproducing organisms.

70051T
L.III - 35%
D1 - 49%

Cell division in all woody vascular plants occurs in

A. root meristem only.
B. shoot meristem only.
C. cambium only.
D. apical meristem and cambium only.
E. apical meristem, root tip and cambium.

70061D
L.III - 63%
D1 - NS

The advantage of asexual reproduction from an evolutionary point of view is that

A. all the offspring will be well suited to the same environment as the parents.
B. dispersal into new environments is more readily accomplished.
C. there is less chance of the offspring showing a new recessive character.
D. it allows plant breeders to produce genetically uniform crops.

70071P
L.III - 35%
D1 - 73%

The number of chromosomes in the gametes of an animal is

A. double the number in the body cells.
B. half the number in the body cells.
C. the same as the number in the body cells.
D. always 23.

70082B
L.III - 24%
D1 - NS

When two alternative genes (alleles) occur in a particular individual,

A. one is always dominant over the other.
B. one is always incompletely dominant over the other.
C. an intermediate condition will always result.
D. none of the above is necessarily true.

70092M
L.III - 16%
D1 - 47%

Some characteristics (e.g., red hair in man) "skip a generation". This can occur when they are

A. dominant.
B. incompletely dominant.
C. recessive.
D. homozygous.

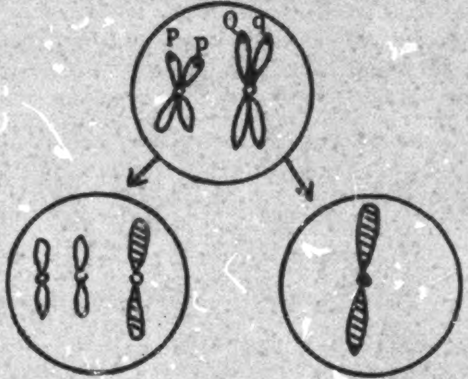
70132F
L.III - 29%
D1 - 33%

Which group of organisms represents the most probable order of succession of plants in a barren, rocky area?

A. mosses, grasses, shrubs, trees
B. lichens, mosses, grasses, shrubs
C. lichens, grasses, shrubs, mosses
D. mosses, lichens, grasses, shrubs

70102Y
L.III - 59%
D1 - NS

Nondisjunction can result in the following type of cell division.



If this occurred, as shown, in an individual that was heterozygous for two characters, as shown, and gamete 1 was fertilized by a gamete carrying the recessive genes p and q, the resulting individual would have

A. trait P and trait Q.
B. trait P and either trait Q or q.
C. trait p and trait q.
D. trait p and either trait Q or q.

One of Mendel's experiments involved crossing pure-breeding peas having yellow seeds with pure-breeding peas having green seeds. All of the seeds from this cross were yellow. On planting these yellow seeds and allowing the plants to self-fertilize, 6022 yellow seeds and 2001 green seeds were obtained.

Mendel planted some of the 6022 yellow seeds and allowed the resulting plants to self fertilize.

70112J
L.III - 60%
D1 - NS

What results should have been expected from this experiment if a large number of seeds were produced by each plant?

A. 1/3 of the plants produced only yellow seeds and 2/3 of the plants produced both yellow and green seeds.
B. 1/4 of the plants produced only yellow seeds and 3/4 of the plants produced both yellow and green seeds.
C. All plants produced yellow seeds.
D. All plants produced green seeds.

70122V
L.III - 35%
D1 - NS

Mendel planted some of the 2001 green seeds and allowed the resulting plants to self-fertilize. What results should have been expected from this experiment?

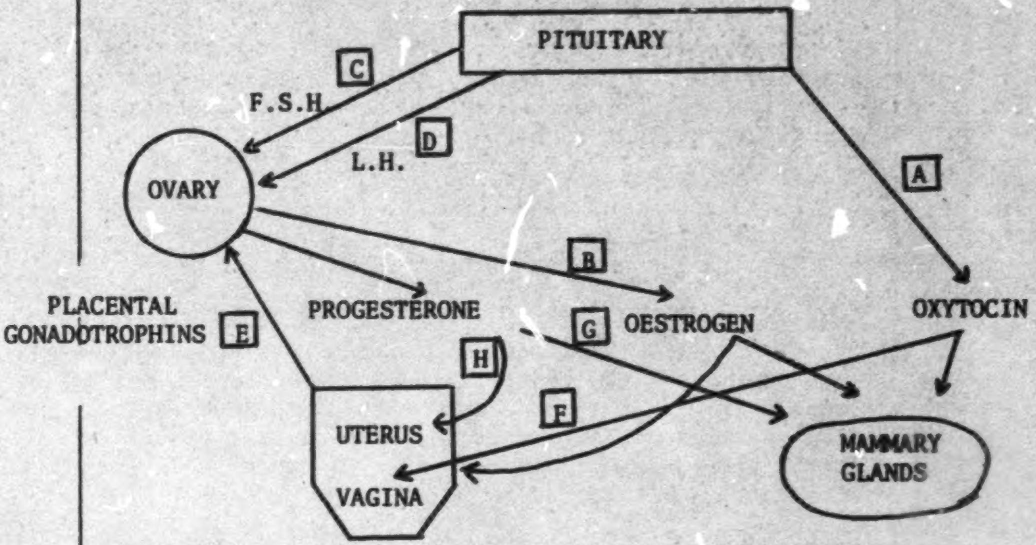
A. 1/3 of the plants produced yellow seeds, 2/3 of the plants produced both yellow and green seeds.
B. 1/4 of the plants produced yellow seeds, 3/4 of the plants produced both yellow and green seeds.
C. All plants produced yellow seeds.
D. All plants produced green seeds.

70143T
L.III 43%
D1 - 48%

In a carefully controlled experiment with the fungus Neurospora the majority of spores were found to germinate and grow on a medium of sucrose, biotin and inorganic nutrients only. A few of the spores, however, required additional organic nutrients before growth proceeded. Which of the following is the most probable explanation of this difference?

A. Some of the spores were mutants lacking certain enzymes.
B. Spores from another fungus had entered the medium.
C. Some of the spores were sterile.
D. Neurospora is evolving and producing a new species with different nutritional requirements.

Study the following diagram, showing hormone secretion in placental mammals.



For the following questions, choose your answer from A to H on the diagram.

70153D
L.III - 61%
D1 - NS

If the basic diagram were used to compare a pregnant kangaroo with a pregnant rat, one arrow would be absent altogether from the kangaroo diagram. Which is it?

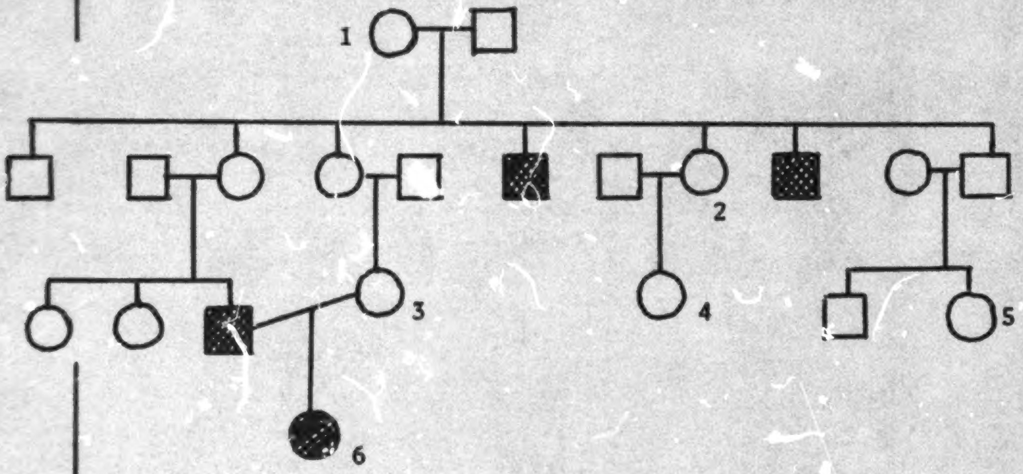
70163P
L.III - 36%
D1 - 60%

Breeding cycles in some animals are seasonal and are initiated by a change in daylength acting on control centres influencing the pituitary. Which hormone would be the first one to be released at the beginning of the breeding cycle?

70173A
L.III - NS
D1. - 35%

In a pregnant animal at full term and at the initiation of uterine birth contractions, secretion of all hormones will be high, except for two. One of these is FSH. What is the other one?

Use this data to answer the following questions.



The chart illustrates a family tree for a family which has a high incidence of the genetic trait called deaf-mutism, which results in deafness at birth.

KEY

▩ deaf-mute male

☐ physiologically normal male

● deaf-mute female

○ physiologically normal female

70183L
L.III - 50%
D1 - 57%

The following are statements about individual number 6. From your knowledge of genetics and an examination of the chart, which one COULD be INCORRECT?

A. Both her grandmothers carried the deaf-mutism gene.
B. Both her aunts carried the deaf-mutism gene.
C. Her father was a deaf-mute.
D. She is a deaf-mute.
E. Her parents were cousins.

70193X
L.III - 50%
D1 - 57%

Why do female deaf-mutes occur only very rarely?

A. The gene is rare and must be possessed by both parents.
B. The gene is nearly always lethal to females at puberty.
C. Males who are deaf and dumb are not usually selected to become fathers.
D. Females who are deaf and dumb are often not intelligent enough to make good mothers.

Answer the following two questions by selecting one of the possibilities from the alternatives below:

A. ≃0 (impossible or very nearly)
B. 0.0625 = 1/16
C. 0.125 = 1/8
D. 0.25 = 1/4
E. 0.5 = 1/2
F. 0.75 = 3/4
G. ≃1 (certain or very nearly)

70203H
L.III - 77%
D1 - 74%

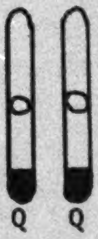
What is the probability that individual 1 carries the gene for deaf-mutism?

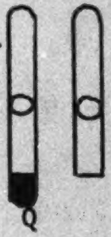
70213U
L.III - 75%
D1 - NS

What is the probability that individual 2 carries the gene for deaf-mutism?

70223E
L.III - 26%
D1 - 38%

Suppose a father with a gene pair QQ and a mother with a gene pair qq have a son. Since the dominant Q should mask the recessive q, the son should display the trait Q. However, it is observed that he displays q instead. Which one of the following chromosome pairs in the son could lead to this situation?

A.


B.


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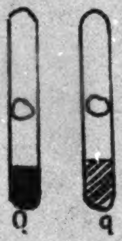

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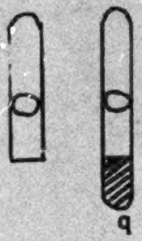


Study the following information and the chart before answering the questions below.

The probabilities of obtaining offspring of various genotypes from two parents heterozygous for two characteristics R and T is illustrated in the chart (sometimes called a punnet square).

♀ \ ♂	RT	Rt	rT	rt
RT	1/16	1/16	1/16	1/16
Rt	1/16	1/16	1/16	1/16
rT	1/16	1/16	1/16	1/16
rt	1/16	1/16	1/16	1/16

70232P
L.III - 69%
D1 - NS

The number of different genotypes obtained from such a dihybrid cross is

A. 16.
B. 9.
C. 8.
D. 6.
E. 4.

70242A
L.III - 48%
D1 - 75%

The probability of obtaining the genotype RrTt from such a cross is

A. 1/16.
B. 1/8.
C. 3/16.
D. 1/4.
E. 5/16.

70252L
L.III - 17%
D1 - NS

The genotype rrtt is said to be

A. angora or persian.
B. lacking in dominance.
C. double recessive.
D. completely heterozygous.

70264Z
L.III - 56%
D1 - NS

Suppose that, from all the different genotypes in the table, only six phenotypes could be distinguished. This would imply that

A. both pairs of alleles exhibited complete dominance of one gene over the other.
B. both pairs of alleles showed complete lack of dominance.
C. there was dominance in one pair of alleles and lack of dominance in the other.
D. gene dominance did not control the phenotype in this particular example.

For each of the questions following, select from the answers below, the alternative which would best account for the probabilities shown in the punnet square:

A. a lethal gene combination rr
B. a lethal gene combination tt
C. a more complex lethal gene combination than either A or B above
D. linkage between Rt and rT genes
E. linkage between RT and rt genes

70272H
L.III - 48%
D1 - 72%

♂

♀	RT	Rt	rT	rt
RT	1/12	1/12	1/12	1/12
Rt	1/12	1/12	1/12	1/12
rT	1/12	1/12	o	o
rt	1/12	1/12	o	o

70282U
L.III - 49%
D1 - 65%

♂

♀	RT	Rt	rT	rt
RT	1/9	1/9	1/9	1/9
Rt	1/9	o	1/9	o
rT	1/9	1/9	o	o
rt	1/9	o	o	o

Evolution

80011U
L.III - 52%
D1 - NS

Natural selection is sometimes described as the "survival of the fittest". The fittest, in this context, means those organisms which

A. live longest.
B. can obtain most food.
C. are most resistant to disease.
D. produce the largest number of healthy offspring.

80021E
L.III - 51%
D1 - 65%

What has the greatest influence in allowing natural selection to take place?

A. variation
B. ecological change
C. isolation

80031Q
L.III - 23%
D1 - NS

Many types of bacteria which were previously sensitive to antibiotics like penicillin are now resistant. This is probably because

A. inferior quality penicillin is used today.
B. bacteria have become accustomed to penicillin because of frequent exposure to it.
C. resistant strains of bacteria have been selected out from the original population.
D. atomic fallout has changed the bacteria, making them resistant to penicillin.

Use the following information to answer the questions below:

In England two forms of the peppered moth exist, a light coloured form and a much darker form. In addition, in industrial areas the tree trunks on which these moths rest during the day are much darker than in non-industrial areas, because of pollution.

In the 1950's a group of biologists released a large number of moths in two localities and later tried to recapture them. Their results are shown below.

Area	Moths Released		Moths Recaptured	
	Dark	Light	Dark	Light
Non-polluted	488	496	34	62
Polluted	493	137	73	10

80043D
L.III - 27%
D1 - NS

From this table it seems likely that, of the following factors, the one with the greatest survival value for all the moths was the

A. degree of pollution of the environment.
B. number of moths released.
C. camouflage possibilities of the resting places.
D. darkness of the moths' colourings.

80054Q
L.III - 27%
D1 - 41%

A weakness of the experimental design, to do with moths in the polluted area, was the

A. large number of dark ones released.
B. small number of light ones released.
C. large number of dark ones recaptured.
D. small number of light ones recaptured.

80064B
L.III - 40%
D1 - 54%

An overall weakness of the experimental design was that

A. moths were released only in two localities.
B. moths were released only in the U.K.
C. moths were released only in the 1950's.
D. only two kinds of moths were released.

80074M
L.III - 20%
D1 - 28%

If the results in the table are taken as truly representative, it is likely that before industrial pollution became widespread one of the following would have been true. Which situation is most likely?

A. There would have been a greater proportion of dark moths.
B. There would have been about the same proportion of dark moths.
C. There would have been a smaller proportion of dark moths.

80084Y
L.III - NS
D1 - 65%

The alpine Ranunculi (buttercups) in Tasmania are interesting to classify. Two recognized species R.decurvus and R.concinnus differ in a very minor but obvious detail: whether the hairs on the leaves and stems are appressed (R.decurvus) or stick out (R.concinnus). R.decurvus is found in habitats at a lower altitude than R.concinnus. The two species maintain their different characteristics when cultured together at the same altitude. Their breeding relationships are not known. Which of the following statements best fits the above data?

A. The two species evolved differently at different altitudes.
B. R.concinnus evolved the "hairy" condition to withstand the cold.
C. R.concinnus and R.decurvus are identical species which grow differently at different altitudes.
D. Nothing can be hypothesized until breeding experiments are carried out.

80094J
L.III - 63%
D1 - 67%

Some recognised eucalypt species in Tasmania, e.g. *E. risdoni* and *E. amygdalina*, which occur on dry mudstone soils, are known to interbreed and produce a hybrid type which has characteristics intermediate to the parent species. These intermediate types are fertile. Which of the following statements about the species concept would the above information best fit?

A. Eucalypts are very indistinguishable and cannot be put into species.
B. *E. risdoni* and *E. amygdalina* are examples of Tasmanian eucalypts which do not obey the rules.
C. Mudstone soils are conducive to the production of hybrids.
D. *E. risdoni* and *E. amygdalina* cannot be different species because of the strict rules which are applied by biologists.

Foliage from trees is the major source of food for the African elephant, who obtains this food by using its trunk to strip the tree of its leaves.

Over many thousands of years the trunk of the elephant increased in length to enable it to reach higher into trees to obtain more food.

A prominent scientist once explained the development of the trunk as follows:

> "During an elephant's lifetime he had to stretch his trunk to enable him to reach the food resources higher in the trees. This meant that the offspring of this elephant also had a longer trunk."

80104V
L.III - 28%
D1 - 42%

The theory outlined was most probably proposed by

A. Darwin.
B. Wallace.
C. Lamark.
D. Malthus.

80114F
L.III - 49%
D1 - NS

The proposed theory of evolution of the elephant's trunk is based on

A. environmental change.
B. genetical variation.
C. chance mutation.
D. geographical isolation.

Each of the questions below is a person's comment. These comments are not all based on fact, but you are required to consider the comment itself rather than whether it is true. For each comment choose, from the following key, the most appropriate description:

A. It would provide better evidence for Darwin's evolutionary theory than for Lamark's.

B. It would provide better evidence for Lamark's evolutionary theory than for Darwin's.

C. It would provide about equal evidence in support of both theories.

D. It would not really provide evidence in support of either theory.

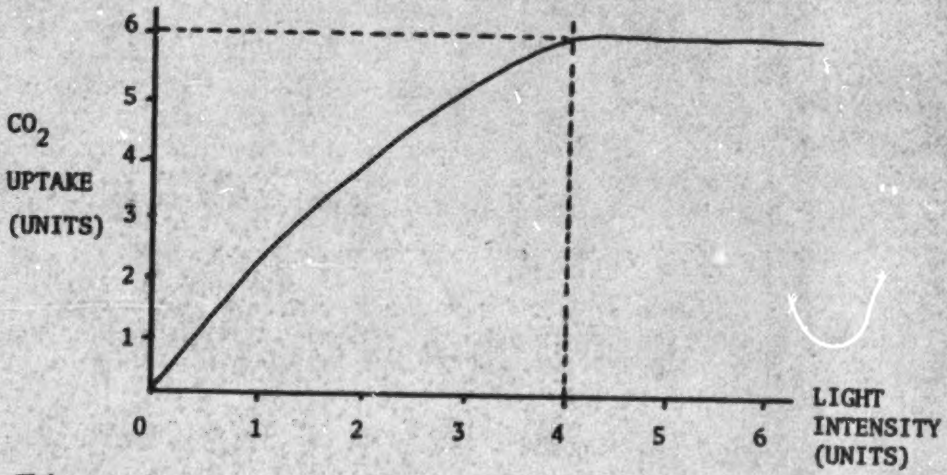
80124R L.III - 37% D1 - 43%	"I've been a chicken farmer for years and have noticed that, if I clip their wings for several generations, then eventually I don't have to do this any more because later generations can no longer fly."
80134C L.III - NS D1 - 59%	"Good teaching of one generation is one way to raise the innate intelligence of disadvantaged people over a period of several generations."
80144N L.III - 51% D1 - 64%	"I trained hard for athletics for many years before and after my marriage but my son seems to be no fitter than any of his class-mates."
80154Z L.III - 30% D1 - 36%	"Women generally live longer than men, but are not so strong physically."
80164K L.III - 35% D1 - 44%	"Over a number of years, I've noticed that it's the mares with the best performers among their ancestors who produce the best colts, rather than the mares who have been well-trained themselves."
80174W L.III - 81% D1 - NS	"The best way to get good strawberry plants is to plant out runners from successful older plants."
80184G L.III - 61% D1 - NS	"Tall parents, on the whole, have tall children."
80194T L.III - 61% D1 - 70%	"I'm an only child and my mother died in child-birth, but I'm sure she was badly frightened by a snake when she was young because I'm terrified of them."

Other : Scientific Method, etc.

90011N
L.III - NS
D1 - 28%

A scientist believes that the release of zinc ions into a river could be causing the death of the fish that normally live there. This idea, before it is tested experimentally, is called

A. a theory.
B. a deduction.
C. an hypothesis.

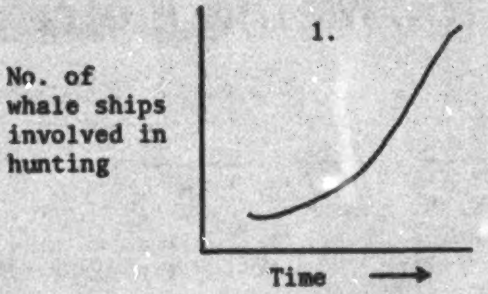


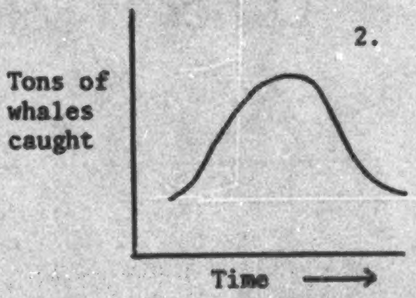
90022A
L.III - NS
D1 - 40%

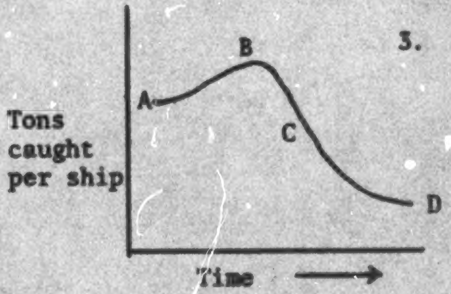
This graph shows the way in which the rate of photosynthesis varies with the strength of light to which a plant is exposed, provided that there is an unlimited supply of carbon dioxide. A valid deduction from the graph is that

A. as light intensity increases, so photosynthesis increases until it stops altogether.
B. the rate of photosynthesis increases until the light intensity reaches 4 units and then the very strong light causes a decrease in photosynthesis.
C. the rate of photosynthesis is constant before the light intensity exceeds four units.
D. the rate of photosynthesis is constant after the light intensity exceeds 4 units.

Look at these graphs about whaling:







90032L
L.III - 40%
D1 - 46%

Graph 3 was derived from graphs 1 and 2. At which point in time were the whales closest to extinction? Choose your answer from the points on graph 3.

90042X
L.III - NS
D1 - 44%

A biologist injects some blood from a sheep with a disease into ten healthy sheep. If eight of the healthy sheep develop a disease with the same symptoms, which of the following conclusions is justified?

A. The disease is caused by a microorganism.
B. The disease is caused by a toxin.
C. Something present in the blood causes the disease.
D. There is insufficient evidence to reach any of these conclusions.

TREATMENT	RESULT
No light	no germination
Red	germination
Red then far-red	no germination
Red then far-red then red	germination
Red then far-red then red then far-red	no germination

90052H
L.III - 45%
D1 - 59%

The data above is from an experiment where seeds were germinated under different wavelengths. From the data, it can be concluded that the properties of the control system in the plant

A. can be switched "on" and "off" by different wavelengths.
B. can be switched "on" and "off" by red light.
C. can be switched "on" and "off" by far-red light.
D. None of the above can be concluded.

The following information relates to the questions below:

A biologist working for a wine company observed that some wines went sour after fermentation. He set up a series of tests as shown below and examined them after 24 and 48 hours.

Test	Medium	Inoculum (material introduced into broth)	Appearance after	
			24 hours	48 hours
1	100 ml sterile broth	1 ml sour wine	cloudy	cloudy
2	100 ml sterile broth	1 ml tap water	clear	cloudy
3	100 ml sterile broth	1 ml boiled sour wine	clear	clear
4	100 ml sterile broth	1 ml boiled tap water	clear	clear
5	100 ml unheated broth	no inoculum	cloudy	cloudy

90062U
L.III - 29%
D1 - 28%

The results obtained in tests 1, 2 and 5 after 48 hours are probably a consequence of the

A. chemical reaction between inoculum and the nutrient medium.
B. growth of microorganisms
C. temperature changes to which the broth was subjected.
D. death of microorganisms inhabiting the nutrient medium.

90072E
L.III - 26%
D1 - 38%

The aim of the experiment was to investigate the effect of varying the

A. inoculum.
B. temperature of the broth.
C. time interval between setting up the experiment and making the observations.
D. extent of cloudiness which develops in the tube.

The questions below are based on the following:

Beetlewax (BW) is believed to prevent colds. To test this belief 20 000 volunteers were divided into groups and each individual took a pill every morning for one year.

GROUP	NUMBER IN GROUP	CONTENTS OF PILL
I	4750	5 grams of sugar
II	4750	5 grams of sugar & 1 gram of BW
III	4750	5 grams of sugar & 3 grams of BW
IV	5750	5 grams of sugar & 9 grams of BW

90122J
L.III - 10%
D1 - NS

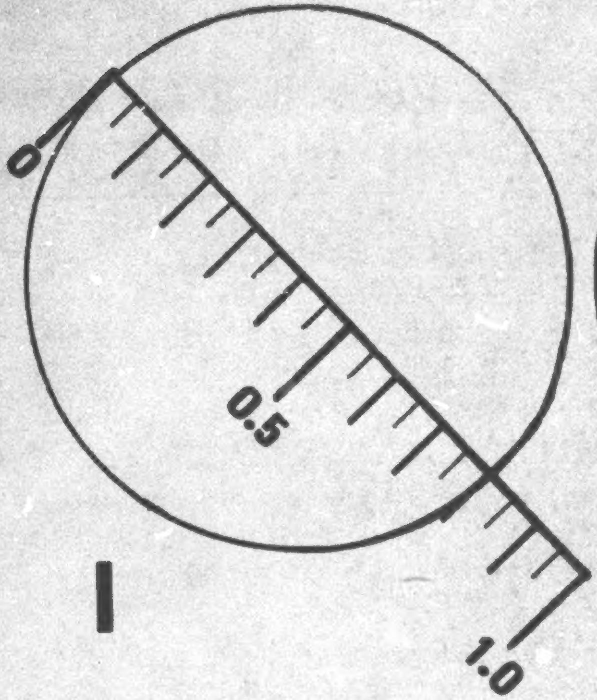
Which group served as the control for this test?

A. I
B. II
C. III
D. IV

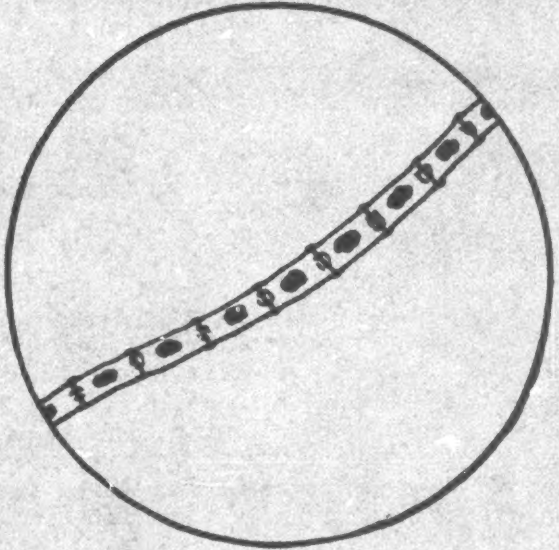
90132V
L.III - 17%
D1 - 28%

20% of the individuals in Group I developed colds during the year as did 19% of Group II, 21% of Group III and 10% of Group IV. From this we can conclude that

A. sugar reduced the number of colds.
B. sugar increased the number of colds.
C. sugar and 3 g or less of BW proved ineffective in the prevention of colds.
D. 9 g of BW prevented colds.



1



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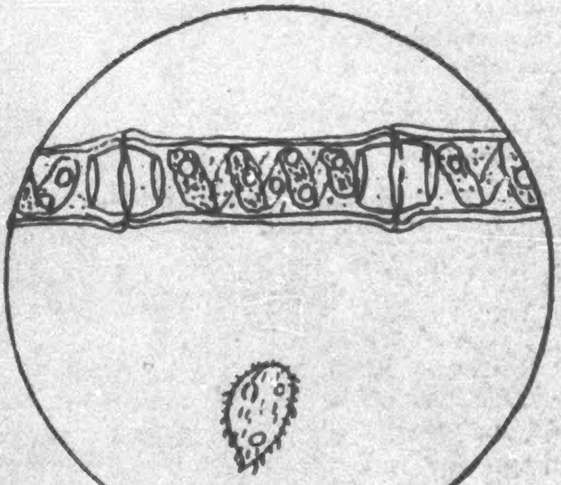

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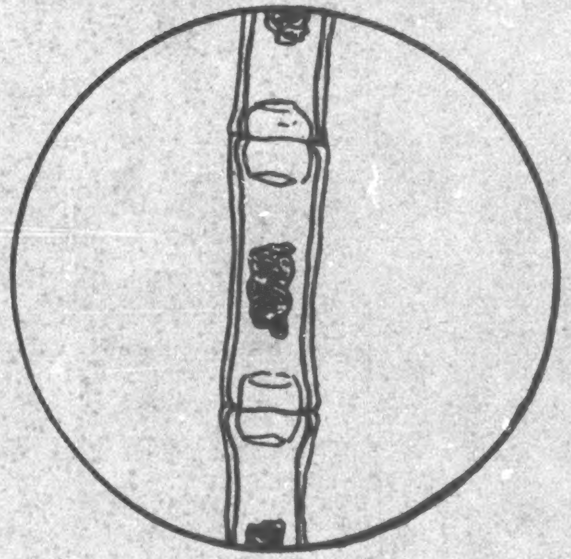


4

The drawings on the previous page are to be used to answer the questions below. Each drawing is the whole field of view as seen with a monocular microscope. The lens combination, X 15 eye (ocular) and X 10 objective, was used to make drawings 1 and 2, whilst 3 and 4 were made using a higher magnification. Drawing 1 shows a 1 mm scale superimposed on the field of view. Drawings 2, 3 and 4 are of the same filament of an alga - Spirogyra sp.; 3 is in its normal state whilst 2 and 4 have been placed in a 0.5 M salt solution.

90082Q
L.III - 54%
D1 - NS

The diameter of the field of view in 3 and 4 would most closely approximate to

A. 200 µm.
B. 350 µm.
C. 0.5 mm.
D. 3.5 mm.

90092B
L.III - 47%
D1 - 54%

The most likely number of cells per metre of a filament of this species of Spirogyra would be

A. 10.
B. 100.
C. 1000.
D. 10 000.

90102M
L.III - 59%
D1 - 69%

Of the following the nearest approximation to the length of the motile microorganism shown in 3 would be

A. 10 µm.
B. 20 µm.
C. 40 µm.
D. 80 µm or more.

90112Y
L.III - 64%
D1 - 72%

The motile microorganism shown in 3 was seen to pass from one side of the field of view to the other in exactly 2 seconds. From the alternatives below, its most probable speed in mm min^{-1} (millimetres per minute) would be

A. 6.
B. 12.
C. 30.
D. 300.

90224V
L.III - 12%
D1 - 24%

A biology student is invited to act as an assistant to his doctor, a general practitioner. He makes the following four observations:

1. A patient with a high fever sweats profusely.
2. A patient with an eye infection constantly wipes the watery discharge from his eye.
3. A patient with a cold has a "runny" nose.
4. The infected sore on a patient's arm discharges a watery pus.

Which of the following hypotheses best accounts for all of these observations?

A. Sick people always have fevers which cause them to sweat.
B. The body tissues produce fluids when foreign invaders enter them.
C. All infections produce the same reaction in all patients.
D. Infections always cause fever and fever always causes sweating.

Bacteria consist of two main groups, autotrophs and heterotrophs. The only certain way that heterotrophic soil bacteria can be classified is by their behaviour on different nutrient media. Lockhead isolated soil bacteria on a non-selective medium and then tested the bacteria on media of decreasing simplicity. He found seven groups which grew on the following media.

Group A - Medium A consisting of glucose - nitrate medium.
B - Medium A plus mineral salts and 10 amino acids.
C - Medium A plus cysteine and seven growth factors.
D - Medium B plus growth factors.
E - Medium C plus the addition of a yeast extract.
F - Medium D plus the addition of a yeast extract.
G - Medium D plus the addition of a yeast and a soil extract.

90143G
L.III - 62%
D1 - 66%

Several hypotheses could be made. Which of the following is least likely to be true?

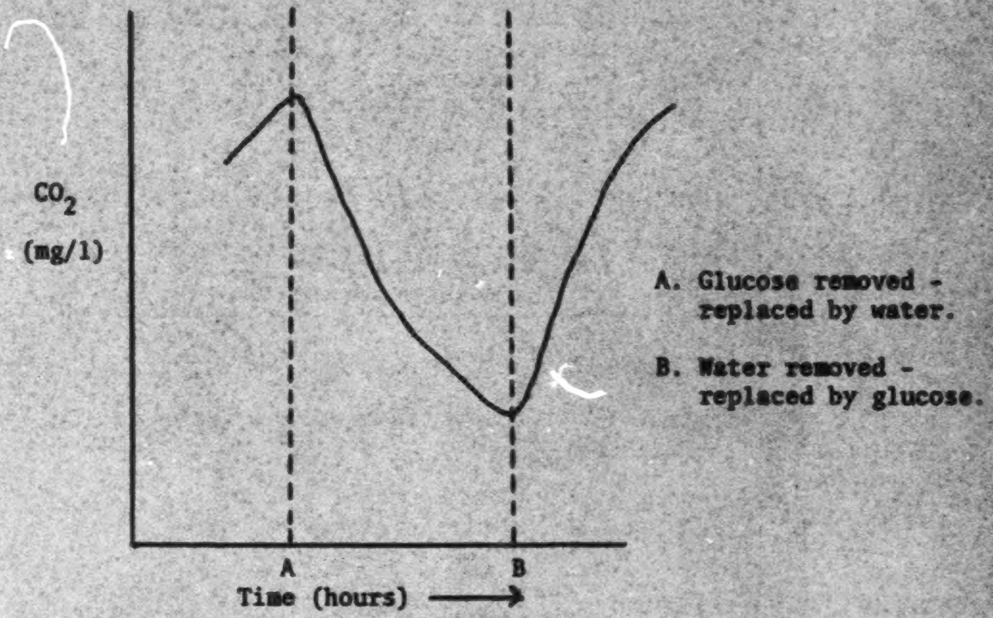
A. Fertile soils will contain a greater proportion of bacteria with complex requirements.
B. A soil extract from an infertile soil will have a smaller growth promoting power than that from a fertile soil.
C. Bacteria in the immediate vicinity of plant roots fall more into groups B, C, D than more complex groups and would decrease in proportion away from plant roots.
D. Fertilizing the soil would decrease the proportion of bacteria with complex growth requirements at the expense of those with simple growth requirements.

90153T
L.III - NS
D1 - 72%

Which of the following is an unfair criticism of the experiment?

A. The experiment provided no means of estimating or grouping autotrophs in the procedure and results.
B. Various growth factors, e.g. Vitamin B_{12} are present in yeast and soil extracts which could have affected (if added) groups C and D.
C. It measures the properties of the soil only and does not allow for inherent properties of bacterial populations which could result in nutritional requirement changes.
D. It is possible that, as some groups of bacteria can exist in several forms, classification into groups could mean the same type of bacteria being in two groups.

Kosinski grew a fungus, Aspergillus niger, in a sterilized situation on a nutrient medium containing glucose. The respiration rate was determined by carbon dioxide output. By means of a siphon arrangement the glucose medium was drawn off at will and replaced by water. The curve obtained is shown below:



90164E
L.III - NS
D1 - 56%

Which of the following best explains the curve obtained?

A. When glucose is removed and replaced by water there is a rapid fall in the rate of respiration.
B. The lower the respiratory rate of the fungus at which glucose is added the more rapid is the increase in respiratory rate.
C. Changes in the respiratory rate of Aspergillus niger are dependent on the amount of glucose substrate present.
D. Glucose is replaced by other substances which can serve as respiratory substrates to a limited extent only.

90174Q
L.III - NS
D1 - 60%

When conducting the experiment, which was the factor that least concerned Kosinski?

A. The temperature of the fungal environment remained stable.
B. The concentration of oxygen in the fungal environment remained constant.
C. The acidity of the medium on which the fungus grew remained constant.
D. The intensity of light to which the fungus was subjected remained constant.

Dish No.	Dish Content	Reaction to test for Sugar	Reaction to test for Starch
1	Halved maize grains soaked in water placed on starch agar	+	+ except in areas where seeds were
2	Halved maize grains soaked in F.A.A. placed on starch agar	-	+
3	Starch agar	-	+ in all parts of dish
4	Plain agar	-	-
5	Halved maize grains soaked in water placed on plain agar	-	-

The above data are results from an experiment on maize grains.

90184B
L.III - 30%
D1 - 49%

The positive reaction to sugar in dish 1 is probably due to a compound which has been

A. secreted by the seed.
B. given off by the starch agar.
C. contained in the water.

90194M
L.III - 18%
D1 - 17%

The negative reaction to sugar in dish 2 is probably due to the fact that the maize grains were killed

A. when cut into halves.
B. when soaked in F.A.A.
C. by the starch agar.
D. by saturation with water.

90204Y
L.III - 60%
D1 - NS

The purpose of dish 4 is a direct control for dishes

A. 3 and 5.
B. 2 and 5.
C. 1 and 3.
D. 1 and 2.

90214J
L.III - 26%
D1 - 41%

The purpose of dish 5 is a direct control for dish

A. 1.
B. 2.
C. 3.
D. 4.

APPENDICES

APPENDIX A(1)

BLUEPRINT OF ITEMS IN THE BANK

LEVEL III

Content Areas	Mental Processes				Total	%
	(1) Knowledge	(2) Comprehension	(3) Application	(4) Analysis		
(0) Diversity	41	52	3	2	98	29.3
(1) Inter-relationships	11	39	1	1	52	15.6
(2) Change	0	17	0	1	18	5.4
(3) Living World	1	27	2	0	30	9.0
(4) Organs, Systems	4	28	1	0	33	9.9
(5) Interaction, Maintenance	2	4	5	4	15	4.5
(6) Cellular Level	8	20	0	0	28	8.4
(7) Continuity	7	11	8	1	27	8.1
(8) Evolution	3	0	1	13	17	5.1
(9) Other	0	10	1	5	16	4.8
Total	77	208	22	27	334	-
%	23.1	62.3	6.6	8.1	-	100

Of the 469 items on which data from trialling was obtained, 334 proved acceptable for Level III. This represents 71% of all items trialled.

In all, 381 are published in the Bank, or 81% of those trialled.

APPENDIX A(2)

BLUEPRINT OF ITEMS IN THE BANK

DIVISION 1

Content Areas	Mental Processes				Total	%
	(1) Knowledge	(2) Comprehension	(3) Application	(4) Analysis		
(0) Diversity	37	57	3	2	99	31.2
(1) Inter-relationships	8	40	1	1	50	15.8
(2) Change	0	20	0	1	21	6.6
(3) Living World	1	27	2	0	30	9.5
(4) Organs, Systems	4	23	2	0	29	9.1
(5) Interaction, Maintenance	2	2	5	5	14	4.4
(6) Cellular Level	7	19	0	0	26	8.2
(7) Continuity	5	5	6	0	16	5.0
(8) Evolution	1	0	0	12	13	4.1
(9) Other	1	10	2	6	19	6.0
Total	66	203	21	27	317	-
%	20.8	64.0	6.6	8.5	-	100

Of the 469 items on which data from trialling was obtained, 317 proved acceptable for Division 1. This represents 68% of all items trialled.

APPENDIX B

TAXONOMY OF EDUCATIONAL OBJECTIVES : COGNITIVE DOMAIN

SUMMARY OF BLOOM'S CLASSIFICATION

1.00 Knowledge - answered by recognition or recall, i.e., memory only.

1.10 Knowledge of Specifics - to do with specific and isolable bits of information, e.g., When did Cook first arrive in Australia? What does "Taxonomy" mean?

1.20 Knowledge of Ways of Dealing with the Specifics - to do with conventions, trends, sequences, classifications, categories, criteria, methodology (N.B. merely knowing, not using these), e.g., Under what conditions is a comma used?

1.30 Knowledge of Universals and Abstractions - to do with principles, generalisations, theories, structures (N.B. again, merely knowing, not using these), plus drilled calculations. E.g., State Newton's Laws of Motion.

2.00 Comprehension - answered by understanding, without making much use of the understanding gained.

2.10 Translation - changing from one form to another, e.g., rephrase a sentence; "read" a graph, music, plans, or table of figures; translate into/from French; draw a graph from data; sketch a geometrical figure from data, etc.

2.20 Interpretation - understanding the major ideas in a communication, including recognising the limits of interpretations which may be drawn, e.g., preparing a coherent summary; distinguishing warranted from unwarranted conclusions; putting things into order (based on understanding, NOT on memory).

2.30 Extrapolation - extending trends beyond or between the information given w.r.t. time, topic or number, e.g., drawing conclusions which summarise a trend; predicting consequences of courses of action; predicting relative probability of conclusions; distinguishing value judgements from predictions of trends; filling in gaps in a table; estimating values which are "off" a graph page; going from a sample to a universe and vice versa.

3.00 Application - answered by recognising some unprompted generalisation, and then using it.

4.00 Analysis - answered by recognising relationships, organisational principles, bias, etc.

5.00 Synthesis - answered by putting things together to make a coherent whole, e.g., writing a letter or essay for a purpose; drawing up plans; composing music or a poem or a plan of action; making discoveries; making hypotheses; preparing a lecture; making an impromptu speech; setting exams; planning a teaching unit. N.B. Merely stringing facts together is NOT synthesis, even if it is asked for in essay form.

6.00 Evaluation - answered by logically supporting judgements with reasons, e.g., judging sheep; comparing possible courses of action; preparing a critical review of a book; marking an essay; writing a school reference.

N.B. Evaluation is NOT involved if the decision is obtained from memory.

* * * * * *

APPENDIX C

STATISTICAL NOTES

(a) Sampling

The problem was to trial 469 items on the 1507 Tasmanian students taking H.S.C. Biology at Level III and also on the 811 students taking it at Division 1, in 1974. These items were trialled in October and early November of that year. Factors complicating the sampling were that a high return of answer sheets could not be guaranteed, that some items tended to be in rather lengthy units and that we wanted to keep the trial tests reasonably short for convenience of administration in the schools.

Basically, a form of random test sampling was decided on, each test to take about one hour and hence be restricted to 33 or 34 items. Thus 14 tests were to be used and about 3000 student answer sheets needed to give around 100 responses per test (and so per item). It was estimated that if each school was asked to give one test to each Level III student and 2 to each Division 1 student, then, allowing for non-returns, the numbers should have been achieved.

In constructing the tests substantial thought was put into randomising as much as possible the content areas, mental processes required and types of items. As a result the tests were reasonably similar in structure, and we assumed that they were sufficiently so to allow each to be regarded as a random sample of the infinite test - i.e., the bank. Thus an item's PBC, obtained from the item analysis, was assumed to be an approximation to the item's correlation with the bank as a whole, and hence that these correlations were comparable test to test.

As a result of trialling, the average number of Level III students answering each item was 82, which fell within the range of numbers we had hoped for. The average number of Division 1's answering each item was 73, again about what we had expected. No test, at either level, had fewer than 61 pupil answers.

(b) Item Analysis

The Department's Item Analysis computer programme was used, and this gave a considerable amount of information about each item. (See Appendix E for an example of this.) The two figures used for further calculations on accepted items were:

(i) Right PBC : the point-biserial correlation between the score on the item and on the rest of the test;

(ii) Wrong RF : the proportion attempting the item and getting it wrong.

(c) Initial Calibration of Items

Two steps were necessary. The first was to make an arbitrary decision about the bank characteristics as a whole; the second was to derive a series of measures for each item, based on the bank figures.

(i) Bank Characteristics. The eventual purpose of the Self-Moderation Procedure is to give schools information about the numbers of C's, P's, L's and N's they should award in the subject for both Level III and Division 1. It seemed reasonable to use the consolidated awards for the state in 1974 as the basis of these:

for Level III :	C	10.01%
	P	46.99%
	L	20.10%
	N	22.90%
for Division 1 :	C	8.95%
	P	58.46%
	L	19.49%
	N	13.10%

Given these percentages, it was possible to calculate the mean z score for each category, if a normal distribution were assumed (which seemed reasonable). The formula,

$$z = \frac{f(\alpha) - f(\beta)}{F(\beta) - F(\alpha)}$$

where f, F have their usual meanings, was used. This formula gave z scores of 1.76, 0.46, -0.45, -1.32 for Level III, and z scores of 1.81, 0.34, -0.76, -1.63 for Division 1.

(ii) Item Characteristics. If the regression of y on x is linear, the predicted value of y(y') from a given value of x is

$$y' = \frac{r\sigma_y (x - \bar{x}) + \bar{y}}{\sigma_x}$$

where the symbols have their usual meanings. This equation can be used to link item characteristics with the Bank characteristics.

Suppose the overall facility of an item (F) is defined to be the proportion not getting it wrong. Then F = 1 - (Wrong RF). Also, F is equal to the mean score on a one-mark item, and the standard deviation of the item is $\sqrt{F(1 - F)}$. Hence if y = a student's score on the item,

$$\bar{y} = F \text{ and } \sigma_y = \sqrt{F(1 - F)}.$$

Further, if x = a score on the test as a whole,

$\bar{x}$ = the mean score of all candidates on the test,

and σ_x = the standard deviation of these scores,

then $\frac{x - \bar{x}}{\sigma_x}$ is a z score on the test, which provides the link with the z scores in (i) above.

The predicted facility for a candidate on the item (F'), then, is given by substituting these values into the regression equation, as the Right PBC is a correlation coefficient:

$$F' = zr\sqrt{F - F^2} + F$$

Thus a Level III C candidate should score F'_c, where

$$F'_c = 1.76\ r\sqrt{F - F^2} + F\ ,$$

and similar expressions can be written for F'_p, F'_l, and F'_n.

An example:

If item 00842Q has a Wrong RF = 0.48, Right PBC = 0.22 for Level III,

$$F = 1 - 0.48 = 0.52$$

$$r = 0.22$$

So $F'_c = 1.76 \times 0.22 \times \sqrt{0.52 - (0.52)^2} + 0.52 = 0.71$

i.e., C candidates should average 0.71 on the item.

$F'_p = 0.46 \times 0.22 \times \sqrt{0.52 - (0.52)^2} + 0.52 = 0.57$

i.e., P candidates should average 0.57 on the item, etc.

The card from which this data was taken is shown in Appendix E.

(iii) Item Calibration

As the F'_c, etc., above are derived using all the data, it is assumed that the total number of Level III students involved in trialling each item are in turn C's, P's, L's and N's. Suppose there were 100 students, then for C's (0.71 x 100) = 71 out of 100 students would have got the item correct; for P's (0.57 x 100) = 57 out of 100 would have got it correct, etc.

Thus the initial data stored for this item would be

credits 71, 100
passes 57, 100

etc.

The correct alternative will also be stored, as will the Access Number.

(d) The Updating Procedure

Suppose a school uses a test containing item 00842Q, and the marking reveals the following:

- The school wants 18 C's, 83 P's, 38 L's and 11 N's.
- Of the 18 highest scorers on the test, 14 get 00842Q right, and of the 83 next highest scorers, 50 get 00842Q right.

The C data for 00842Q will change to (71 + 14), (100 + 18) - i.e., to 85, 118; and the P data will change to (57 + 50), (100 + 83) - i.e., to 107, 183. This updating will occur whether or not the school's expectations are within the range obtained in the moderation procedure - see below.

(e) The Moderation Procedure

This is based on Wood and Skurnik's[2] interpretation of Lawley[3], as has been done in previous Science, Mathematics, Social Science, English and Geography Banks[4-10]. The interpretation suggested below is rather different from that given in the earlier publications, but the same as in the Geography Bank.

(i) Data Supplied by the School
- Unmarked Answer Sheets, e.g., 150 of these.
- Desired distribution of awards, e.g., 18C, 83P, 38L, 11N.
- Access numbers of the items used.

(ii) Steps in the Calculation of the Desired Range

1. The numbers stored for each item are converted back to proportions - e.g., from the 71, 100,

$$\frac{71}{100} = 0.71 = F'_c \text{ for that item.}$$

2. $\Sigma F'_c$ and $\Sigma (F'_c)^2$ are calculated for all items in the test and so $\Sigma\left[F'_c - (F'_c)^2\right]$ obtained.

3. These sums are then multiplied by the Desired Number of C's, N_c, to give:

- expected total of C students = $N_c \Sigma F'_c = T_c$, say,
- sum of variances of C students = $N_c \Sigma\left[F'_c - (F'_c)^2\right] = V_c$, say.

4. Operations 1-3 are carried out for the other categories, and overall sums obtained, thus:

$$T = \sum_i T_i \text{ and } V = \sum_i V_i \text{ , for } i = c, p, l, n.$$

The sum T is the total score forecast by the teacher, on the basis of his pattern of Desired Awards and after varying item difficulties have been considered. It thus represents the number of correct answers he expects his students to obtain, and so can be compared with the number, S, which his students actually achieve.

The sum V can be looked at as representing the error variance of the test, by the following reasoning:

> The amount by which V under-estimates the total test variance is the sum of the covariances between the items multiplied by the appropriate N_i's. These products represent the true variance components of the total test variance, and hence the remaining variance, V, must be the error variance.

This was Wood and Skurnik's interpretation of the work of Lawley, and the basis of the Self-Moderation procedure used in previous banks in this series.

5. Taking V as the error variance the S.E.M. for T must be $\sqrt{V}$, and the 95% confidence interval for T is given by

$$T \pm 1.96\sqrt{V}.$$

The width of this interval is a measure of the uncertainties involved in the teacher's estimation of his students' score on the test chosen.

6. Further uncertainties must be considered when making the transitions from interpreting T as an estimate of performance on the test to interpreting it as an estimate of performance on the whole Bank and, finally, on the course studied. This last interpretation is, of course, the point of the whole Self-Moderation procedure. The transitions can be justified by advice given to teachers in two places in this Bank:

   - First, they are advised to make tests for moderation purposes similar to the Bank itself in regard to spread of content and mental abilities (see page xix). This is the basis of the first transition.
   - Second, they are cautioned about a professional approach, in that they should not restrict their teaching to the type of work which can be tested using items from the Bank (see page xix). This makes the second transition feasible.

To allow for under-estimation of the S.E.M. due to these factors (which must operate to increase uncertainties about T), the range is actually expressed as

$$R = T \pm K\sqrt{V} \ ,$$

where the value of K can be varied. At the time of writing (May, 1975), a value of 2.5 seems to be giving acceptable results - typically, a range which is about 10% of T.

The value to be used in the future is still subject to research. It is doubtful whether any theoretical method of determining the "correct" value will be found, and the value at any time will most probably continue to be decided on empirical grounds like the one mentioned above. On any Moderation Printout, the current value will be given at the top of Column G.

(iii) Calculation of the Actual Score Obtained by the Class

The total number of correct answers is the Class Total Score, S.

(iv) The Moderation

Score S is compared with $(T \pm K\sqrt{V})$. Three cases can arise:

1. $T - K\sqrt{V} \leq S \leq T + K\sqrt{V}$

   In this case, the school would be within the desired range.

2. $S < T - K\sqrt{V}$

   Here the school has been too generous in its Desired Awards.

3. $S > T + K\sqrt{V}$

   Here the school has been too hard.

The school will be informed which category it falls into, and provided with data to amend its Desired Awards if this is necessary AND if the school wishes to do so.

(f) The Error Analysis

Such an analysis will be included with the moderation advice. The basis of the analysis will be as follows:

(i) Each item in the bank will have a number of "labels". These labels will refer to such things as content areas (a finer classification than the 10 broad areas represented by the first digit of the access number), skills, mental processes, difficulty, certain specific errors, etc.

(ii) A selected test will contain items having some of these labels. It is expected that, in any one test, most labels will occur more than once.

e.g., Item 00842Q, the example in Appendix E, has F values 0.71, 0.57, 0.47, 0.37 and one of its labels is CO. The probability of a Level III credit student getting this item wrong is (1 - 0.71) = 0.29 and similarly the probabilities of the other categories of students getting it wrong are 0.43, 0.53, 0.63. We can regard these probabilities as expected scores for the error type represented by CO.

(iii) Wherever label CO appears in the test, similar expected scores for this type of error can be calculated. Hence, by a procedure identical with that described in section (e) (ii) above, we can sum the expected scores and variances over the items labelled CO and find the expected scores and sums of variances of each of the award groups on this error type.

(iv) From this point, the analysis will take two different courses, each of which will eventually lead to a 95% confidence interval as in (e) (ii), and each of which is based on data supplied by the school choosing the test. For both intervals, K will be used instead of 1.96.

Suppose with 150 students, the school wants 18C, 83P, 38L and 11N.

1. The group taking the test will first be regarded as average, and hence to have the same proportions in each category as the state overall. Thus the number of credits for Level III in the group = 10.01%* of 150 = 15, and the numbers in other categories will be 70, 30 and 34 respectively. These numbers, with the expected scores and sums of variances from (iii) above, will allow the calculation of the range of numbers of CO type errors to be expected if the group is average. Call this R_A.

2. An exactly similar calculation, but using the desired awards of the school, will give the number of CO type errors to be expected if the group is distributed as the school thinks it is - i.e., 18, 83, 38, 11. Call this range R_D.

(v) During the marking of the answer sheets, the CO type errors actually made will be counted - S_{CO} say.

(v[illegible] Finally S_{CO} will be compared with both R_A and R_D, in a very similar way to that in the Self-Moderation Procedure itself, and a comment will be made if S_{CO} falls outside either or both R_A and R_D. This comment should form a basis for both diagnostic and remedial action by the teachers.

(vii) Similar calculations will be made for all labels represented in the test chosen, a comment being made only when an error count falls outside a range.

(g) Computer Programmes

For this Bank, these will carry out stages (b), (c)(ii), (c)(iii), (d), (e) and (f). Also an access programme to inspect item data will be used frequently, to decide whether items should remain in the Bank or be withdrawn.

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* These percentages will be continually updated as the Bank is used, by adding desired awards to the original state distribution. Initially they will be the percentages on page 106.

APPENDIX D

BASES OF THE ERROR ANALYSIS PROCEDURE

Mental Processes

P_1	knowledge
P_{11}	knowledge of specific facts, definitions
P_{12}	knowledge of ways of dealing with facts, categories
P_{13}	knowledge of abstractions and generalisations
P_{14}	knowledge of routine calculations
P_2	comprehension
P_{21}	translation
P_{22}	interpretation
P_{23}	extrapolation
P_3	application
P_4	analysis
P_{41}	detection of mistakes
P_{42}	recognition of bias, style, etc.
P_{43}	distinguishing assumptions, etc.
P_5	synthesis
P_6	evaluation

Item Difficulties

D_1	easy items (difficulty less than 30%)
D_2	items of medium difficulty
D_3	hard items (difficulty greater than 70%)

Content Areas

C0	Diversity
C01	classification - bases of
C011	classification - levels of
C012	classification - living v. non-living
C013	classification - plants v. animals v. micro-organisms
C014	classification - plants
C015	classification - animals
C016	classification - micro-organisms
C02	species definition
C03	structure and symmetry
C04	types of nutrition

C1	Interrelationships
C11	food and energy
C12	communities
C13	succession
C14	food web and food chain
C15	diffusion
C151	diffusion and osmosis
C152	diffusion and heat transfer
C153	diffusion, rates
C154	diffusion and active transport
C16	factors of survival
C17	parasitism, commensalism, mutualism and disease
C18	adaptations
C181	adaptations - plants
C182	adaptations - animals
C19	activity and behaviour

C2	Change
C21	population changes
C22	variations
C23	natural selection
C24	mutation
C25	fossils
C251	fossil record
C252	fossils and evolution
C26	distribution and isolation

C3	Living World
C31	biosphere
C311	biosphere - balanced systems
C312	biosphere - man's effect on
C313	pest control
C32	input/output
C321	input/output re: matter
C322	input/output re: energy

C4	Organs, Systems
C41	plant - photosynthetic system
C412	plant - transport system
C413	plant - responses
C414	plant - reproductive system
C42	animal systems
C421	animal circulatory systems - blood and lymphatic
C422	animal endocrine system
C423	animal nervous system
C424	animal digestive system
C425	animal gas exchange
C426	animal reproductive system
C427	animal excretory system

C6	Cellular Level
C61	cells - structure and components
C62	cell chemistry
C63	enzymes
C64	cellular respiration - as a process
C65	photosynthesis - as a process
C66	transpiration - as a process

C7	Continuity
C71	cell division and growth
C72	cell differentiation
C73	asexual reproduction
C74	sexual reproduction
C75	reproduction and variability
C76	physiology of reproduction
C77	patterns of heredity
C78	chromosomes and genes
C79	gene action

C8	Evolution
C81	theories of evolution
C82	primate evolution
C83	cultural evolution

C5	Interaction, Maintenance
C51	homeostasis, feedback
C52	chemical co-ordination, hormones
C53	physiology of learning
C54	tropisms
C55	immunology

C9	Other Content
C91	scientific approach, method
C92	hypothesis making
C93	hypothesis testing
C94	designing expts.
C95	history of science, and scientists
C96	laboratory techniques
C97	laboratory equipment
C98	microscopes
C99	experimental controls

Other Bases for Errors

E1	graph interpretation - linear scales
E2	graph interpretation - non linear scales
E3	diagram interpretation - realistic
E4	diagram interpretation - relationships
E5	map interpretation
E6	table interpretation
E7	photograph interpretation
E8	interpretation of articles
E9	quantitative approaches
E10	hypothetical situations
E11	classifying organisms
E12	using taxonomic names
E13	basic chemical ideas

E14	chemical reactions
E15	philosophical problems
E16	lengthy stimulus material
E17	structure - function relationships
E18	interpretation of experiments

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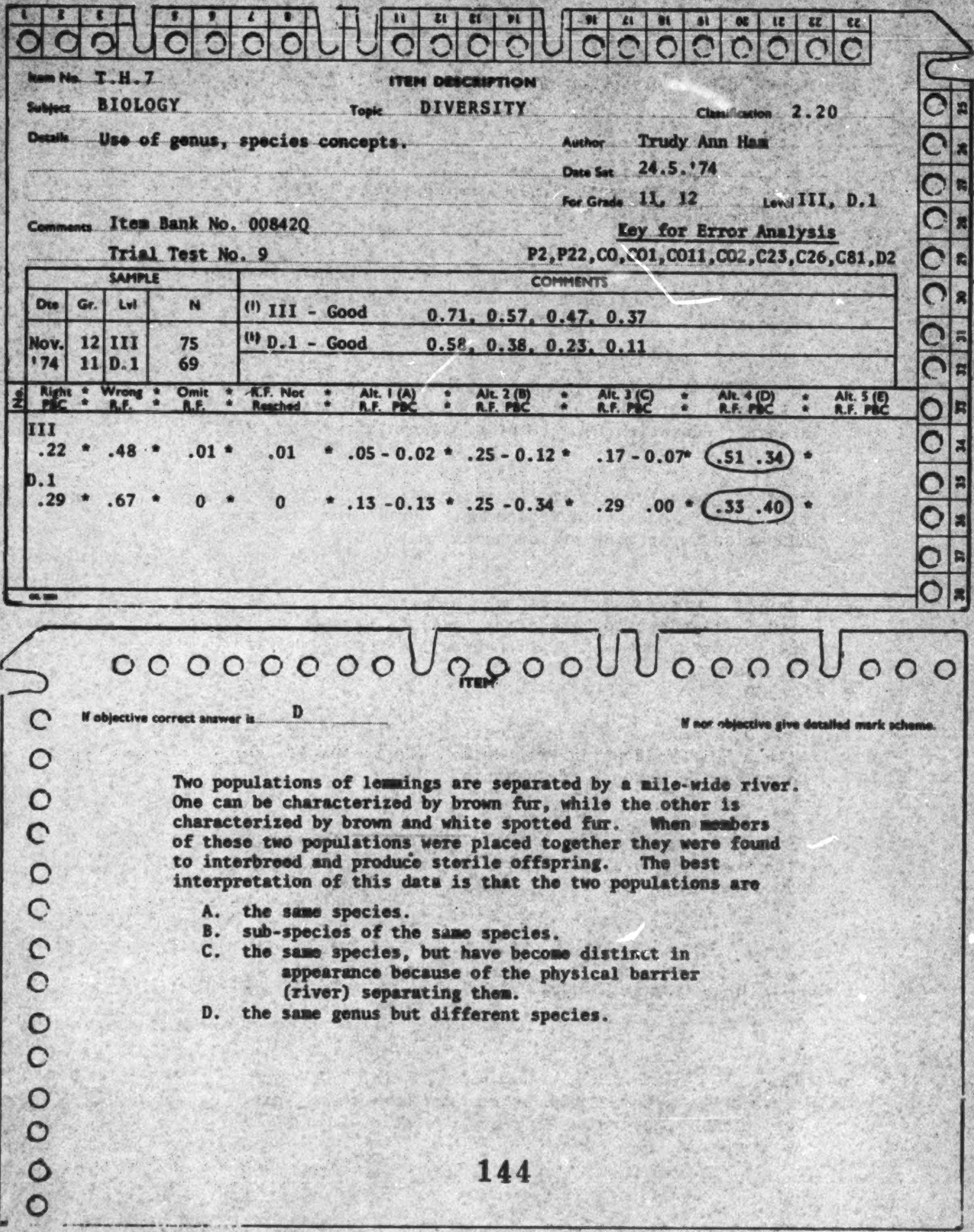
APPENDIX E

A TYPICAL COMPLETED ITEM CARD



Item No. T.H.7

ITEM DESCRIPTION

Subject BIOLOGY Topic DIVERSITY Classification 2.20

Details Use of genus, species concepts.

Author Trudy Ann Ham

Date Set 24.5.'74

For Grade 11, 12 Level III, D.1

Comments Item Bank No. 00842Q

Trial Test No. 9

Key for Error Analysis

P2,P22,C0,C01,C011,C02,C23,C26,C81,D2

SAMPLE				COMMENTS
Dte	Gr.	Lvl	N	
Nov. '74	12 11	III D.1	75 69	(1) III - Good 0.71, 0.57, 0.47, 0.37 (1) D.1 - Good 0.58, 0.38, 0.23, 0.11

No.	Right PBC	Wrong R.F.	Omit R.F.	R.F. Not Reached	Alt. 1 (A) R.F. PBC	Alt. 2 (B) R.F. PBC	Alt. 3 (C) R.F. PBC	Alt. 4 (D) R.F. PBC	Alt. 5 (E) R.F. PBC
III	.22	.48	.01	.01	.05 - 0.02	.25 - 0.12	.17 - 0.07	.51 .34	
D.1	.29	.67	0	0	.13 -0.13	.25 -0.34	.29 .00	.33 .40	

ITEM

If objective correct answer is D

If not objective give detailed mark scheme.

Two populations of lemmings are separated by a mile-wide river. One can be characterized by brown fur, while the other is characterized by brown and white spotted fur. When members of these two populations were placed together they were found to interbreed and produce sterile offspring. The best interpretation of this data is that the two populations are

- A. the same species.
- B. sub-species of the same species.
- C. the same species, but have become distinct in appearance because of the physical barrier (river) separating them.
- D. the same genus but different species.

APPENDIX F

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T. J. Hughes, Government Printer, Tasmania